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ILLUSTRATING THE REPORT

OF THE

PAINT VALLEY RAILROAD SURVEY

BETWEEN

HILLSBOROUGH AND CHILLICOTHE

IN THE

STATE OF OHIO

BY ELLWOOD MORRIS, C. E.

M18 Atlas

NOTE.

MILES.

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ilroad line as proposed between the same points, will probably measure 190

any uncontrolled by local influences, might bring this distance own to about 175

al line from Cincinnati to Parkersburg (the terminus of the Baltimore io Railroad) passes 3½ miles south of Hillsborough—10 miles south of the—7 miles south of Athens.

e line from Hillsborough to Parkersburg; leaves Chillicothe 7 miles to h, and Athens 6 miles.

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REPORT

Morris

UPON THE

RAILROAD SURVEYS

BETWEEN

HILLSBOROUGH AND CHILLICOTHE,

IN THE

STATE OF OHIO,

BY THE VALLEY OF PAINT CREEK.

CONDUCTED BY

ELLWOOD MORRIS, C. E.,

UNDER THE DIRECTION OF

B. H. LATROBE, ESQ.,
CIVIL ENGINEER.

CINCINNATI:
BEN FRANKLIN BOOK AND JOB OFFICE, WALNUT STREET, ABOVE PEARL.

1851.

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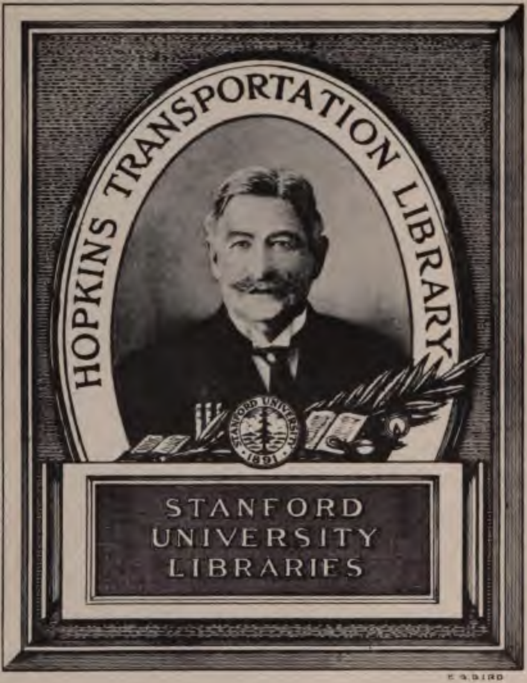

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INTRODUCTION.

TO BENJAMIN H. LATROBE, ESQUIRE,

CIVIL ENGINEER; CONSULTING ENGINEER OF THE PAINT VALLEY SURVEYS.

SIR:—I have the honor to submit, most respectfully, for your information, the following Report on the Railroad Surveys, lately executed by me under your advice, between the Towns of Hillsborough and Chillicothe, in the State of Ohio, by the route along the leading Valley of Paint Creek.

For the sake of perspicuity, even at the risk of some repetition, I have divided this Report into the following heads, viz:

1. Geology of the Country Surveyed.
2. Topography about Hillsborough.
3. Railroad Lines, about ditto.
4. General Topography of the Country.
5. General Principles governing the Surveys.
6. Rocky Fork and Paint Valley Line, Located.
7. Fall Creek Ridge, and Paint Valley Line, Explored.
8. Turnpike Modification at Chillicothe.
9. Estimates of Cost.
10. Comparison of Lines traced.
11. Hillsborough and Cincinnati Railroad.
12. Railroad Surveys hitherto made.
13. Comparison of preferred route, with Greenfield Line.
14. Prospects of the East and West Thoroughfare.
15. Concluding Remarks.

Coming into this State under your direction, with the view of contributing my efforts to the settlement of a disputed Engineering question of importance, to the success of the East and West Line across Southern Ohio, projected as the continuation of the Baltimore and Ohio Railroad to the City of Cincinnati, I have found with regret, a people so greatly divided on the subject of the Route for this portion of the Thoroughfare Line of Railway, that in the war of interest and feeling to which these distractions have led, the through Line is likely to be entirely lost sight of.

This state of things unfortunately still continues, and we see a Company originally organized to build the through road, and not now commanding the one-fourth part of the capital necessary to make it east of Chillicothe alone, engaging on the one hand in schemes, for extensions west, and on the other, battling with a company who propose without charge, or prejudice to them, to finish the Road through from Cincinnati to Chillicothe, leaving their means wholly unimpaired, and much more adequate to the great task of connecting Chillicothe with Parkersburg.

I respectfully commend this state of things to your serious consideration, in your approaching visit to this State, in the full belief, that a crisis now exists in the affairs of the East and West Line across Southern Ohio, of such a nature, that unless the present strife can be allayed, in a way that will bring all the divergent energies into one concurrent channel, the through Line must for the present, sink amidst the clashing of these hostile interests.

It had been my intention in this Report, to have thrown out some suggestions for a compromise of the difficulties alluded to, but they have reached a pitch, that requires a more potential voice than mine to still them; I therefore most respectfully submit that matter to you, well knowing the weight justly attached to your views, in the Southern Counties generally, as well as in the City of Cincinnati, the great centre of vitality, for the Railroad System, in this quarter.

REPORT.

I. OF THE GEOLOGY OF THE COUNTRY BETWEEN HILLSBOROUGH AND CHILLICOTHE.

The reports upon the Geology of Ohio, by Professor Mather, and his assistants, have elucidated very clearly, the character, and order, of the various groups of stratified rocks present in this State, and have given at the same time, some highly important information relative to the physical geography of the country.

The "*Blue Limestone formation*" extends transversely eastward, from near the Indiana state line, to an outcrop of the "*Cliff Limestone*" not far from the dividing ridge between the waters of the Scioto and the Little Miami.

Here the "*Cliff Limestone formation*" begins some miles west of Hillsborough, and extends eastward, entirely across Highland county, and into the western part of Ross, showing itself for the last time near our railroad grade, at the "*Big Falls*" of Paint Creek.

Near this place, the "*Black Shale formation*" commences, and extends easterly to a point near Chillicothe, where we enter the "*Waverly Sandstone formation*," through which at this place the Scioto river winds its way.

All railroad lines therefore, running eastward from Hillsborough to Chillicothe, begin in the "*Cliff Limestone*" and crossing the "*Black Shale*" terminate in the "*Waverly Sandstone*." These conditions are common to all the routes surveyed, and they show that no apprehensions need be entertained in this district of country, relative to procuring suitable building stone, for mechanical structures of any weight, except for a short distance in the "*Black Shale*."

For the researches of the Geologists, have conclusively shown, that both the "*Cliff Limestone*" and the "*Waverly Sandstone*" abound in building materials of good quality, while even the "*Black Shale*" furnishes some few strata of stone suitable for square drains, and rough walls, if not for Bridge Abutments.

The Geologists have also satisfactorily shown, in their report of 1838 (2nd Annual) that the original surface of Ohio was formerly a gently sloping plain, out of which diluvial currents of vast power, have scooped the vallies, and left rounded remnants of the ancient plain, projecting now, far above the general grade of the surface, and forming the present hills of Ohio, which near the margins of the larger water courses, are high, and numerous, and being "*hills of denudation*" without orderly arrangement, are very perplexing to the engineer and require a great deal of surveying, to draw railroad lines amongst them to the best advantage.

These conditions of the physical geography of Ohio, will be recognized by all who are familiar with the state, and might be much further illustrated, if it were necessary for our object.

The summits of these hills, (where least disturbed,) show a remarkable similitude of level, nor is evidence wanting, that the surface of the state, in remote ages, has been swept by currents of ample power, to produce the changes supposed, in the original plain—for they have strewn upon the soil of Ohio, along with the ruins of her own rocks, the rounded fragments of others, foreign to her geology.

These gravel deposits, form in many places hills, and ridges, of great value to the engineer, as furnishing the finest possible materials for the surface of Turnpike roads, and for the Ballasting of Railway Tracks. This is peculiarly the case within the limits of the "*Black Shale*" along the course of Main Paint Creek, where gravel (the "*debris*" of harder rocks) is very convenient, and abundant.

Another incident of the geology of this portion of the State, favors the engineer materially in undertaking railroads across Highland and Ross counties. It is, the fine growth of white oak timber, upon the "*Blue Limestone*" and "*Cliff Lime-*

stone," and the abundance of locust and poplar, on the "*Black Shale formation*."

These brief references to the geology of this section of country are sufficient for our purpose—they explain the character of the materials with which we have to deal, and apprise us beforehand of the leading features of the surface we have to cross.

Thus near the crops of the "*Cliff Limestone*" with the "*Blue*," we should expect, rugged hills, and ridges, projecting from the general surface and approaching the softer formation of the "*Black Shale*;" geology cautions us, to look for chasms, gorges, and falls, in the course of the streams; while upon the body of the formation of "*Cliff Limestone*" we should be led to expect table lands, level, or but slightly undulating.

All these natural deductions from the geology of the country, are verified by the facts of the case—but it seems unnecessary to extend this branch of the subject further than to remark, that as we shall have some heavy cuts in the "*Cliff Limestone*," Professor Locke's statement of its physical character is of importance in this connexion.

"*The Cliff Limestone* (says Professor Locke, in the 2nd geo-"logical report of Ohio, 1838) is very various in its character; "in different localities, and even in the same locality, the same "solid rock will present several horizontal layers, very different "from each other."

"It is generally less hard and compact than the "*Blue Lime-"stone*;" often extremely soft and friable, like loose sandstone; "sometimes porous, and spongy like pomice stone, as at Eaton, "in Preble county; arenaceous, containing silicious sand as "at *New Union*, and *Madison*, Indiana; compact and marble-"like, as at the Dayton quarry."

A rock with such characteristics cannot be difficult to work. Indeed we know that it is quarried with great facility at Hillsborough, and that at the mouth of Blinco Run, it is so soft, that it may be hewn into any shape with the greatest ease, and with the most imperfect tools.

Cellars blasted out of this rock in the town of Hillsborough, under circumstances more unfavorable, than occurs in Railroad cutting, have cost for excavation, and removal, ***only sixty cents***, per cubic yard.

II. OF THE TOPOGRAPHY ABOUT THE TOWN OF HILLSBOROUGH.

A reference to the accompanying maps will render more clear the following remarks :

The town of Hillsborough, the seat of Justice of Highland county, Ohio, stands upon some elevated ridges, or summits, (between the waters of the Rocky Fork of Paint Creek, and those of Clear Creek, the largest tributary of the Rocky Fork,) the Court House being nearly upon the apex.

This town, (whose name is characteristic,) is one of the most elevated spots in the State, being about 670 feet above low water mark of the river at Cincinnati ; it stands nearly 5 miles east of the main ridge, dividing the waters of the Scioto, from those of the Little Miami, and yet singularly enough, the ground to the west falls off so rapidly, that the outer depot is reached by the railroad from Cincinnati, with ***a descending grade***, from the Scioto and Miami summit.

Hillsborough is by the traveled roads 55 miles distant from Cincinnati ; 38 miles from Chillicothe ; and 45 miles from Maysville, Kentucky.

The water sheds off from the summit occupied by the town of Hillsborough, in *three* principal directions. *Northerly*, by Trimble's Branch of Moberly's Branch of Clear Creek—*Southerly*, by Town Branch of the Rocky Fork—and *Easterly*, by Wolf Run, a confluent of the Rocky Fork.

This arragement of the water shed, produces several summit ridges, which essentially control the location of railroad lines about the town, and render various combinations practicable, while augmenting the difficulties of all.

The summits in the vicinity of Hillsborough, across which railroad lines have been traced, are *five* in number, all within, or near the town plat.

Their relative positions will be more readily appreciated by reference to the accompanying map of railroad lines, traced around the town of Hillsborough by the engineers of the Hillsborough and Cincinnati Railroad Company; the principal ones—the northern line by Trimble's summit, and the southern by Matthew's summit, having been verified by our own surveys.

These summit ridges, and their elevations, are given in the following tabular statement:

TABLE OF SUMMITS AT HILLSBOROUGH.

<table>
<tr><th rowspan="2">NO.</th><th>Elevation <i>above</i> the grade of the outer depot at A</th><th>Elevation <i>above</i> low water mark of the Ohio at Cincinnati.</th><th rowspan="2">DESCRIPTION.</th></tr>
<tr><th>in feet.</th><th>in feet.</th></tr>
<tr><td>1</td><td>66</td><td>678</td><td><i>Trimble's Summit,</i> top of ridge north of the residence of W. H. Trimble, Esq., the summit between Wolf run and Trimble's branch of Moberly.</td></tr>
<tr><td>2</td><td>56</td><td>668</td><td><i>Matthews's Summit,</i> south-east of the Female Seminary, dividing Wolf run from the Town branch of Rocky Fork.</td></tr>
<tr><td colspan="4">These two summits (1 and 2) form part of the same ridge running nearly north and south.</td></tr>
<tr><td>3</td><td>47</td><td>659</td><td><i>Price's Summit,</i> taken on the turnpike, near the residence of Hon. John Winston Price, is traversed lengthwise by the turnpike, west of the seminary, and divides the waters of Town Branch of Rocky Fork and Trimble's Branch of Moberly.</td></tr>
<tr><td>4</td><td>56</td><td>668</td><td><i>Walnut Street Summit</i> is formed by the ridge on which Walnut street runs west of High street, and divides the waters of Town Branch and Rocky Fork, from the drains of Moberly, west of the town of Hillsborough.</td></tr>
<tr><td colspan="4">These two summits (3 and 4) are upon different parts of the same ridge, running nearly east and west.</td></tr>
<tr><td>5</td><td>59</td><td>671</td><td><i>Academy Point</i> is the promontory between Trimble's Branch and the other drains of Moberly further west.</td></tr>
<tr><td colspan="4">This summit (No. 5) is merely a prong jutting out from the main ridge dividing Rocky Fork and Clear Creek, upon which are summits 3 and 4.</td></tr>
</table>

Arrived at this stage of our investigations, we see in fact, that the summits at the town of Hillsborough, are formed by two ridges nearly at right angles, and a prong of one.

Of these two ridges one runs north and south, near the eastern margin of the town plat, and the other through it, east and west, diverging gradually westward and southward from Main street, near Judge Price's.

On the first, or north and south ridge, are found Trimble's and Matthew's summits, (1. and 2.)

On the second, or east and west ridge are situated, Price's and Walnut street summits, (3. and 4.)

And of this east and west ridge the ***Academy Point***, (5,) is a prong, or promontory, jutting out to the north, and capable of being turned in that direction, but not by an available railroad line.

We have taken some pains to illustrate the position of the summits at Hillsborough, because upon a proper understanding of their situation, elevation, and relation to each other, depends the means of appreciating, both the combination of railroad lines practicable about the town, and the relative merits of those practicable routes.

These summit ridges are all formed of rock, and present expensive, but not impracticable barriers, to the construction of a railroad grade.

They are composed of the "*Cliff Limestone*" of the geological classification of Ohio—a rock not difficult to remove, and abounding with building stone of excellent quality.

III. OF THE RAILROAD LINES TRACED ABOUT HILLSBOROUGH.

In continuing the Cincinnati and Hillsborough Railroad, from the outer Depot grounds, near Hillsborough, eastward, by the Rocky Fork line, towards Chillicothe, several lines are practicable.

All of these, leave the Depot west of Hillsborough, at the same point, and unite again upon the line eastward by the valley of the Rocky Fork of Paint Creek, either at the mouth of Clear Creek, or on Wolf Run, between its mouth and Hillsborough, as is shown upen the map.

Therefore the true comparing points of these lines, uniting on the Rocky Fork—points which are common to all—are the Hillsborough Depot, (**A.**) and the mouth of Clear Creek, (**K.**)

The following table shows at one view the general characteristics of each.

TABLE OF LINES ABOUT HILLSBOROUGH REFERRING TO THE MAP.

NO.	Designation on the Map.	Proximate length from Depot to the mouth of Clear Creek	Proximate excess of length over the shortest, or Trimble's line by Wolf run.	Degrees of curvature turned approximately.	Elevation of Main summits.		Description.
					Above Depot Grade at A	Above low water at Cin'ati.	
		Feet.	Feet.	Degrees.	Feet.	Feet.	
1	**A. C. D. F. K.**	34,000	0	441°	66 & 59	678 671	North line by Trimble's Summit.
2	**A. B. D. F. K.**	36,000	2,000	523°	56 & 56	668 668	South line by Matthews's summit.
3	**A. B. E. F. K.**	36,000	2,000	651°	56	668	Town Run line.
4	**A. G. H. L. K.**	39,600	5,600	475°	0	612	Moberly' Branch and Clear Creek line.
5	**A. O. H. L. K.**	41,800	7,800	582°	56	668	Trimble's Branch, Moberly's and Clear Creek.
6	**A. B. J. H. K.**	46,400	12,400	726°	56 & 47	668 659	Southern line, Price's Summit, Trimble' Branch, Moberly and Clear Creek.

In ascertaining the curvature turned on the Northern line, (No. 1) our actual location by the Rocky Fork has been taken.

Of these several lines, the great additional length of Nos. 4, 5 and 6 excludes them from competition with the rest, though there is reason to believe that (No. 4,) the route by Moberly's Branch and Clear Creek, to the Rocky Fork, has the cheapest grade of all, while it has no summit to pass.

Of the other three, the line by Town Run, to the Rocky Fork, when examined in the field, shows such a want of adaptation between the ground, and the maximum grade, as well as such abrupt angles to be rounded—or pierced by tunnels—as to render it impracticable at a reasonable cost.

The competition is thus narrowed down to a comparison of the merits of Nos. 1 and 2, commonly known as the northern and southern lines at Hillsborough.

The northern line, (No. 1,) has decidedly the advantage in point of length and straightness, it encounters two summits, the Academy and Trimble's—the southern line (No. 2.) also crosses two summits, Walnut street and Matthews's, the first being lower than the Academy by 3 feet, the second lower than Trimble's by 10 feet—the southern line has therefore the advantage in point of maximum depth of cut.

Owing however to the sudden rise of the collateral ridges preceding the Walnut Street Summit, next the Depot, the maximum grade runs at once under ground, rendering a long thorough cut necessary before the Walnut Street ridge can be cleared, while it continues cutting and filling over ridges and ravines—the drains of Town Run—until Matthews's summit is approached, when another considerable cut becomes necessary.

This configuration of the ground, gives a heavy profile, and causes the southern line to have a deeper average cut, and larger quantities of excavation than the northern.

The broken character of the ground south of the town, and the necessary extent of the cuts and fills, is unfavorable to the establishment of Depots, while the ascent and descent is such as to demand an almost constant use of the maximum grade of 50 feet to the mile, either rising or falling—little opportunity offering for the location of a sufficient length of the level line, or slight grade, appropriate to Depot grounds.

In fact, the southern line, in the opinion of the writer, is only to be made practicable, with due regard to cost and Depot arrangements, by an alteraion of the present grade of the Hillsborough and Cincinnati Railroad, for a mile or more, back of the present outer Depot grounds.

Even then, its aggregate cost could scarcely be brought down to that of the northern line, but if (in the absence of exact estimates for which the time could not be commanded,) we even admit, an equality in that respect, its additional length of 2,000 feet, its greater crookedness by *eighty-two* degrees of curvature, and the consequent perpetually greater expense of working and maintaining in use, would appear to forbid its adoption, from engineering considerations.

The northern line without inconvenience, avails in a proper manner of the Depot grounds now belonging to the company, it leaves the question of Depot, (always a delicate one,) entirely undisturbed, and precisely where it has been placed by the Directors of the Company, who formally acted upon it.

The inner, or passenger Depot, heading upon Main street, can be reached by a **Y** line, the eastern curve being turned on a radius of 1,042 feet, the western with 674 feet, (both uniting on the same switch,) while the tangent, or tail of the **Y** line, running into the passenger station, will be upwards of 700 feet in length, straight, and generally level.

This will make a convenient arrangement for a passenger Depot in this difficult place, and it will admit of turning engines, without a platform, while the Depot can be left with facility, either east or west—the position of the cars reversing, if not backed down.

The curves of this **Y** line being upon the Depot side track, (clear of the main line,) are far from being objectionable, they are even quite favorable, and may if necessary be further shortened, without materially impairing their utility.

The engineering attributes of the southern line being so forbidding in many leading points, the writer therefore, in full view of the importance of this question to the town of Hillsborough, and with the hope of contributing something towards its definitive settlement, would recommend the northern Rocky Fork route, gaining the waters of Wolf Run, by crossing the Academy point, and Trimble's summit, as forming decidedly the most feasible railway line, for leaving the main Hillsborough Depot, eastward, as well as the best to approach, and use, the grounds possessed by the Company, at both the Depot sites.

The above remarks proceed upon the supposition, that the "*Rocky Fork Line*" might possibly be adopted for the route to Chillicothe, for if the "*Fall Creek Ridge Line*" be selected, no question of Depot can be raised, as the main line in that case can only approach the town upon the west, near enough to gain the Depot grounds by a switch line, and cannot be under any circumstances, made to pass around upon its southern side.

Whichever route therefore may be adopted, the present Depot grounds will answer their purpose, and can be gained by switch lines with equal facility.

IV. OF THE TOPOGRAPHY OF THE COUNTRY EASTWARD OF HILLSBOROUGH.

Looking eastward from Hillsborough, we perceive a tract of country east of Clear Creek, about 13 miles long, and 3 or 4 in width, drained mainly by the confluents of the Rocky Fork, aided towards the eastern border of Highland county, by Plum Run, a western drain of main Paint Creek.

The district of country referred to, is bounded on the north by the southern ridge belonging to Fall Creek, and the lower drains of Rattlesnake, and on the south by the Rocky Fork, itself.

This tract of country lays directly in the path of railroad routes towards Chillicothe, and would be crossed near its northern borders by air lines drawn from the Hillsborough Depot to Chillicothe, or to Kilgores Mill, the place selected for the passage of the Scioto, by all the engineers who have surveyed east and west railroad lines, from Clincinnati, across southern Ohio.

The shortest railroad line towards Chillicothe, would therefore run within it, and though, practicable at a sufficient limit of expense, would be a forced location across the drainage of the country, and consequently, a costly one.

All railroad lines traced east of Hillsborough with due regard to cost, must flank this district—skirting it either north, or south, —turning the heads of most of the drains, *if north*—crossing them at moderate elevations near their mouths in the Rocky Fork bottoms, *if south*.

The first leading feature in the topography of this district of country referred to, is the ridge upon which the town stands, and which divides the waters of Rocky Fork, and Wolf Run, from the Clear Creek valley.

This main ridge near the town of Hillsborough is broken only by *Moberly's Branch*, (a confluent of Clear Creek,) which drains the western front of the place, and enables a railroad line, availing of its valley, to gain Clear Creek, without encountering any summit, within the limits of the maximum grade—and with no unusual cost—though necessarily traced pretty high up along the slope of the right bank, broken continually, by the collateral drains.

A railroad line availing itself of the valley of Moberly's Branch, has distance enough, to grade in, to reach Clear Creek advantageously, and to pass it at a moderate elevation.

Arrived at Clear Creek, two main routes present themselves for gaining the table lands, turning the Rocky Fork drains by the north, and finally reaching the heads of Plum Run, and descending to Paint Valley by the course of this stream, which is highly favorable, for direction, and not unfavorable for slope.

The first of these lines, crossing Clear Creek very obliquely south of Albert Swearingens, would cut through the narrow ridge dividing Clear Creek, from Dickeys Run, into John Nelson's meadows, and gaining the valley of Shoemaker's Branch, a favorable, though, circuitous hollow, would ascend its northwestern side slope, and passing very near Shoemakers, and north of Gordon Pogues, attain the summit dividing the waters of Clear Creek, and Fall Creek, upon the farm of Silas Hogshead, about a quarter of a mile, east of his buildings. The ground here is 31 feet above the Depot grade, at Hillsborough, and 643 feet above low water mark, at Cincinnati.

Here we are fairly upon the southern ridge of Fall Creek and by pursuing it upon highly favorable ground. we may turn all the Rocky Fork drains, or pass them at will, where they are very small, and offer but trifling obstacles.

A short distance beyond the summit at Hogsheads, we come upon the Anderson road, at its intersection with the road from Hillsborough to Greenfield.

These cross roads, conform in level to the grade of 50 feet to the mile, by which we have descended east from Hogshead's summit. We now reach the farm of Jonathan Spohn, where the other route referred to above, connects with this line.

This second route would also cross Clear Creek obliquely very near Albert Swearingen's buildings, and cutting across the small ridge upon which James Trimble's house stands, some 300 yards south of the house, would follow along near one of the Greenfield lines, over the broken ground, in a north-easterly direction to the farm of John Bunton, here sweeping to the east, this route would pass, north of Bunton's house, and cross the dividing ridge between Clear Creek and Fall Creek, near the house of Wm. Nevins. From this summit, (where the ground surface is elevated 49 feet above the grade of the outer Depot at Hillsborough, or 661 feet above low water mark at Cincinnati,) we pass near Evan George's house, thence skirting the point of the hill at John George's, in the valley of Fall Creek, we should run straight towards Spohn's farm, and unite with the main line, by Fall Creek ridge.

These are the two main routes, and of these the Shoemaker's hollow line admits of two deviations.

The first cuts across the point, in front of Mr. John Nelson's, passes near Elton's smith-shop at the cross roads, and either re-enters the hollow near there, or continues in cutting up to near Shoemaker's and enters there.

The second deviation leaves the hollow south of Shoemaker's barn, and runs straight over Pogue's summit, keeping in the woods, south of his fields.

Having passed this summit, this line may turn either south or north ; if south, it would descend Blinco, and join the Rocky Fork line, near Rainsborough ; if north, it would then, bear up towards the cross roads, to avoid Blinco valley, and join the Fall Creek ridge line, (like the rest) on Spohn's farm.

The relative merits of these modifications of the "*Fall Creek ridge line*," will be more particularly referred to hereafter.

Leaving Spohn's farm eastward, the route would continue along the Fall Creek ridge, gradually drawing over to the south, and crossing the extreme heads of the drains of the Rocky Fork, keeping north of the Quaker meeting house, north of Mrs. Overmans, and of Cogills, and near the north corner of the lot of the Dunkard church.

Arrived at the Dunkard church, (which stands south of a little detached hill,) we see before us to the eastward, an insulated hill, called Parker's hill, about ½ mile long, and which may be turned on either hand—we prefer turning it by the north, with a moderate cut, and descending by a grade of 50 feet to the mile, cross the head of Puncheon with a moderate embankment, and passing north of Absalom Summers, cut slightly through the favorable gap between Hyatts and Ravenscroft's hills, and enter the valley of Plum Run.

All the way from Spohn's farm to Parker's hill, an excellent route would be found about ¼ mile further north, but if followed throughout, it would increase both distance and curvation.

It may however be advantageously availed of from Spohn's to the Dunkard church, and would put the line on better ground at Cogill's, throw it back of Mrs. Overman's, and indeed, it may also be advisable, to run north of the insulated hill, at the Dunkard church.

Having entered the valley of Plum Run, the route would run straight, into the farms of Philip Rhodes, and his sisters, and being probably unable to follow the main stream owing to its crookedness and rapid fall, it would cut the intervening ridge, and gain the south fork of Plum Run, on Henry Foreacre's farm, and thence descending the south fork on very good ground, with a grade of near 50 feet per mile, would pass north of Housemans, James Rhodes, and Mrs. Foreacre's, and re-enter the valley of the main Plum Run, near Crawford's mill.

Thence crossing Plum Run below Crawford's mill, and immediately re-crossing at a favorable chasm of rocks, and a third time, crossing at another chasm, the route unites with the Rocky Fork line at the mouth of Mackerly's hollow, near an old chimney, on Mrs. Clagett's land.

We will now return to the "*Rocky Fork line*" at the head of Wolf Run, and describe the topography by that route, entirely forward to Chillicothe.

The ridge between Wolf Run and Clear Creek, trends south-easterly, and declines gently towards the Rocky Fork, until it arrives at the Highland county Poor house farm, where it slopes rapidly down towards the bottoms of the Rocky Fork, and finally breaks off abruptly, at the landside edge of the bottom lands.

This ridge opposes a barrier to any railroad line taking a direct easterly course, from the town of Hillsborough, or from the valley of Wolf Run,—it could, however, be surmounted if necessary, in order to favor a direct and bold location, across the country *eastward.*

This is evident from the following statement of crest levels, taken at points along its summit going eastward:

PLACE.	Top of Ridge above the Depot Grade.	Approximate Air line distances from Trimble's Summit.
	Feet.	Feet.
Summit back of residence of W. H. Trimble, Esq., 5,600 feet from the Depot grounds.	66	O
At Rhoads', north of Turnpike	53	4000
At Mrs. Brock's, near the Turnpike	42	5400
At Mrs. Miller's, on the Turnpike	20	7600
Depression in the ridge, back of and below the residence of J. Barry, Esq.......................	8 Below.	12300

The next great feature in the topography eastward of Hillsborough is the deep and wide valley of Clear Creek, with its cultivated bottoms.

This valley forms the greatest obstacle in this vicinity, to any direct railroad line run towards Chillicothe from Hillsborough, owing to its proximity to the latter place, its depression below it, and the high elevation at which it must necessarily be crossed by any railroad line reaching it from the west in a short distance.

The following levels elucidate thus.

PLACE.	Levels of water in Clear Creek.	
	Below the Depot Grade at Hillsboro', in feet.	Below the Grade at Trimble's Summit, in feet.
Above the Turnpike, near Mr. Wm. Barry's,......	143	171
At Prior's, below Mr. John Barry's,..............	164	192
At the mouth of Clear Creek,.....................	176	204

Wolf Run, the valley of which may be gained at Hillsborough by cutting through two ridges of "*Cliff Limestone*" [as has been before intimated] has a general south-east course from the town, and offers a favorable opportunity of descending with a grade of 50 feet to the mile, so as to gain the Rocky Fork bottoms before reaching Clear Creek, and enable it to be passed near its mouth at a height, just above the freshets, or highest water mark.

By this route then, we may obtain the command of the ground in advance, with our railroad grade, and overcome completely, the difficulties of Clear Creek.

Clear Creek, has a general south-east course, usually parallel to Wolf Run, and from one to two miles distant from it.

After passing Clear Creek, the face of the country eastward is broken by the drains of the Rocky Fork, only *three* of which head much beyond or north of the Chillicothe and Milford turnpike road—these are Blinco, Puncheon, and Lusatta's Branch.

The heads of Easter's Run, [west of Blinco] come up to the turnpike, east of Boston, though draining but little ground beyond it.

Lusatta's Branch admitting of being turned by the north, Blinco and Puncheon only remain, and these near the turnpike, in a direct line towards Chillicothe, would present no very formidable obstacles to the passage of a railroad line, capable of of overcoming the difficulties of Clear Creek valley, and its bounding ridges, though they would materially enhance its cost.

These streams head against Fall Creek, a drain of the Rattlesnake Fork of Paint Creek, about two miles north of the turnpike.

At the head of Lusatta's Branch, the ridge dividing it from Plum Run, flattens off into a table land, offering great facilities for the easy construction of a railroad grade.

Plum Run, is a western drain of main Paint Creek, next above the Rocky Fork, and forms a favorable—in fact the only suitable break in the border of the cliff limestone formation, by which a railroad can readily descend to the valley of Paint Creek, from the table lands of Highland county.

This descent, over broken ground, requiring heavy cutting and filling, forms one of the greatest difficulties in this railroad route, of which it necessarily forms a part.

This stream heads against Puncheon, on the west, and Fall Creek on the north, and in its valley must unite all railroad lines, or modifications of them, coming in this direction from Hillsborough.

The basis of this system of drainage is the Rocky Fork of Paint Creek, into which Town Branch, Wolf Run, Clear Creek, Easter's Run, Blinco, Puncheon, and Lusatta's Branch, fall in succession proceding from west to east.

Along the Rocky Fork, would pass any railroad line projected from a map of the country, because it is clearly the natural route, the best in point of direction, and would be the cheapest also, but for a circumstance incident to the geology of this portion of the state, which has before been hinted at.

This stream which in the upper part of its course flows in a shallow channel, with a moderate current, and wide cultivated bottoms upon its borders, changes its character entirely for some miles above its confluence with Paint Creek.

In the lower eight miles of its course, it descends about 112 feet, but the greater part of this fall, is concentrated in the last few miles.

It is there found for several miles running in a deep, and crooked chasm, bounded with perpendicular walls of Limestone 60 or 80 feet high, and difficult even to approach.

It is here tumbling off from the harder formation of the cliff Limestone, into the softer one of the Black shale, which first shows its crop in Ross county, near the eastern border of Highland.

It has consequently formed, or adopted for itself a narrow and devious gorge, impracticable for a railroad line within, and scarcely so without, except at great expense, owing to the deep and frequently recurring cuts, fissures and breaks, formed by the collateral drains in the mural cliffs, which hem in the path of the stream on both its banks.

It is in consequence of this peculiarity, [incident to the junction of the two geological formations which here succeed each other,] that we are unable to follow the Rocky Fork to its mouth, and thus gain the valley of Main Paint Creek, with a rairload line.

In crossing the country therefore, we are compelled to seek some other and more moderate break in the cliff Limestone, by which we can leave the table lands of Highland county with a railroad line, and descend by a grade of 50 feet to the mile, to the lower levels of the Black shale formation.

This is fortunately afforded us, by the valley of Plum Run, which though it has a similarly rugged course to the Rocky Fork for a short distance, presents its difficulties on a so much smaller scale, that they may be overcome without serious trouble.

The next great feature in the topography in this direction is Main Paint Creek itself, which is here found running nearly north and south, near the margin of the cliff Limestone formation, and forming the eastern boundary of Highland County.

Its course is here transverse to the direction of a railroad line towards Chillicothe, which must therefore cross it. For this purpose a very favorable position offers at the "*Indian Ford*," which enables the stream to be crossed at an elevation sufficient, to carry a railroad line across a promontory, at the eastern margin of Highland county, which enables an objectionable bend in Paint Creek to be avoided, while it favors the line in its passage from Plum Run.

The "*Indian Ford*" is therefore, a topographical point, to be made by all railroad routes, passing eastward in this vicinity, and here the valley of main Paint Creek is fairly entered.

The banks here, are high on both sides, a projecting table receiving, and coinciding with the grade on the eastern bank, while the valley is narrow, and the bed of the stream a solid rock, combining nearly all the advantages which could be desired for a railroad crossing, of the most favorable kind.

Before quitting this portion of our topography, the writer will observe, that in the vicinity of the mouth of the Rocky Fork, two lines have been pointed out, and much discussed by the neighboring farmers—both have for their object, gaining the table lands of Highland from Paint valley, without ascending Plum Run.

One of these lines would ascend a hollow near the traveled road, in the direction of Craigheads—the other would pass the

Rocky Fork at a favorable chasm bounded by Mural cliffs, and gain the table land by grading up, along the left bank; neither of these routes furnish distance enough to enable the maximum grade to pass the summits in moderate cutting, they would both be very costly, and would lose more distance east of Paint Creek, than they would gain west.

These facts were so evident on looking at the ground, that no survey with instruments was deemed necessary, and whatever their merits, they would have the disadvantage of a cost, too heavy, to admit of the adoption of either.

Resuming the topography proceeding eastward, from the "*Indian Ford*" we observe that the northern side of the valley of Main Paint Creek, north of the Rapid Forge Iron Works, presents very favorable ground for a railroad line, and a good crossing, on a solid rock bottom—offering itself, over Paint Creek, at the "*Big Falls*" where the stream, from peculiar circumstances of the site, may be safely passed at a low elevation, a very direct route, (continued on the southern bank) is feasible, skirting the town of Bainbridge, and crossing Paint Creek again, (the third time) on gravel bottom, a little north of "Seymour's Bridge" on the Milford and Chillicothe turnpike road.

Here, and for many miles forward, Paint Creek winds its way through wide and low bottom lands, well cultivated, and of surpassing fertility.

From Seymour's Bridge, either side of Paint valley may be taken, or a direct line traced through the bottoms, disregarding the creek, and turning its course into new channels at favorable points, to avoid bridging, or should bridging be preferred, but two more, or five in all, would be required.

The railroad in this fine valley (passing just south of the town of Bourneville) needs only to be kept above the level of the highest water mark, it thus becomes, almost wholly an embankment line, and on levees averaging from 6 to 9 feet high, would run by long straight lines and easy curves across the rich arable bottoms, for 16 miles below the "*Indian Ford*" until the "*Cattail bottoms*" are gained.

Arrived at the "*Cattail bottoms*" we have before us to the east, a huge insulated hill, called "*Slate hill*," abutting against a high table land on the north, and bounded south by Main Paint Creek, running there, circuitously through a rather favorable gorge, called the "*Big narrows*."

This insulated hill, is 2⅛ miles thick, east and west, it has about 3½ miles extreme diameter north and south, is about 300 feet high, and forms a fine example of the Ohio "*hills of denudation*," though a provoking obstacle, in the path of a railway east.

A railroad line towards Chillicothe, is obliged by this hill to diverge from its true course, and turn it on one hand or the other, (both routes are practicable) if by the north, then an ascending grade, is necessary, rising from the "*Cattail bottoms*" at 50 feet to the mile, about 40 vertical feet in all, to a summit on the table land within ¾ths of a mile of the "*Slate Mill*" (Judge Morris's) and thence descending, to the north Fork of Paint Creek, at the point south of the mill.

If "*Slate Hill*" be turned by the south, the line would descend the "*Big narrows*" of Paint Creek, keeping the left bank, with a moderately descending grade, on ground generally, a favorable side hill, except at some points, where land slides, are to be apprehended.

In passing around the "*Big narrows*" two very favorable stretches of bottom land, are also to be availed of.

The fall in Paint Creek, from "Cattail Run" to the mouth of the north Fork is only about 38 feet, and the distance by the "*Big narrows*" from the "*Cattail bottoms*" to Carsons, at the mouth of the north Fork, is about 5¼ miles, while turning the hill by the north, by way of the "*Slate Mill*" and the valley of the north Fork, the distance between the same points, is about 5 ½ miles—the narrows route is therefore the shortest by near one quarter of a mile, and is clear of the 40 feet Summit of the other route. By crossing Paint Creek at the Hydraulic dam, and cutting off a great bend on the south side, this line might be availed of to save a mile or more of distance to a through line, by leaving Chillicothe on the north.

The ground north of the "*Slate Hill*" however, being very favorable for an economical railroad grade, and not exposed to the creek, nor liable to land slides, is probably to be preferred, over the route by the *Big narrows.*"

Arrived at the "*Slate Mill*" [Judge Morris's] we have before us to the eastward, [at a distance of about a mile in a direct line] McArthur's hill, another enormous insulated hill, behind which stands the City of Chillicothe.

This hill opposes another barrier, and a formidable one, to the direct entrance of a railroad line, into the town from this side.

McArthur's hill is about 5 miles long, and over a mile in thickness at the base, it stands directly across the path of railroad lines, entering Chillicothe from the west, and screens the City from view, on that side.

The valley of the north Fork, bordering McArthur's hill upon the west, while Main Paint Creek and its bottoms, skirt it on the south, and a high table land upon the north, it admits of being turned on either hand, or crossed by a deep cut, at a favorable gap, where the Milford and Chillicothe turnpike approaches, and enters the town.

Three lines are therefore practicable into Chillicothe from the Slate Mill, the central and shortest one, over the turnpike gap, requiring a cut of about 45 feet maximum depth to enable a grade of 50 feet to the mile to ascend, and cross it from the west—less grade, and less cut, would answer the ground eastward. It is the steepness of the hill slope facing west, that compels the grade, to cut so deeply in.

This cut would only be 1800 feet long between the grade points, on both sides, and being wholly composed of Slate Rock, with intervening layers of sandstone, all easy to remove, and permanent when done, would not be a very formidable undertaking.

The perpendicular elevation, of the summit grade of this deep cut, above the crossing of the north Fork, at the Slate Mill, would be about 60 *feet.*

We have now detailed with great particularity, the topography of the country between Hillsborough, and Chillicothe; in order to show, that no other routes are practicable, in any direct course from the former place, to the latter, except those traced by us, and described in a subsequent part of this report.

V. OF THE GENERAL PRINCIPLES GOVERNING THESE SURVEYS.

By a brief reconnoissance of the country, the writer became satisfied, that it would not be necessary to curve a railroad, any where, between Hillsborough and Chillicothe, at a sharper rate, than three degrees of horizontal deflection, to a chord of one hundred feet, or to use, in the technical language of the engineer, a minimum curve of higher quality, *than a three degree curve.*

Such a curve has a radius of 1910 feet, and was therefore adopted as the least radius of curvature admissible, in this survey, and this position, has been successfully maintained, in all the lines we have traced.

The maximum grade employed upon the Hillsborough and Cincinnati railroad, being $\frac{95}{100}$ of a foot, per hundred feet, or $50\frac{16}{100}$ feet, per mile, that grade, has also been adopted as the *maximum* to be used in our surveys—and with that gradient the country has been successfully crossed.

Now inasmuch, as the grade of $50\frac{16}{100}$ feet per mile, upon the railroad west of Hillsborough (of which our surveys are merely an extension) runs entirely through the minimum curve of that line of 1146 feet radius, the resistance due to such a curvature added to the grade, would make it equivalent, to a gradient, of at least 55 feet per mile upon a straight line; it is therefore, the opinion of the writer, that in constructing the railroad line east of Hillsborough, it would be good policy to adopt a *maximum* grade of 55 feet per mile upon all straight lines (where necessary) and flatten it upon curves, *at the rate of one foot of grade per mile, for each degree of the quality of the curve.* (*See Appendix* **A.**)

A maximum grade run upon the ground on these principles, would save considerable money in constructing the road east of Hillsborough, while a locomotive with a fully loaded train would ascend this grade of 55 feet per mile, upon straight lines, without the expenditure of more power, than would be needed to propel the same load, on the $50\frac{16}{100}$ feet grade, through the 5° curve, along the O'Bannon Creek, before alluded to.

A road so graded, would be equalized throughout, in point of maximum power needed to work it, while money would thus be saved at many difficult points in the construction.

It is probable also, that grades of at least 55 feet per mile, upon tangent lines, will be required, to command the country east of the Scioto, while it is certain, that the employment of such a gradient, would be a measure of economy, in crossing that undulating district of country.

It is in point of fact, the decided opinion of the writer, resulting from his observations in this section of the country, that a higher gradient than 50 feet per mile, is advisable and necessary to obtain the proper control (with a cheap railroad line) over the broken ground to be encountered in southern Ohio, but that a grade of 55 feet per mile on straight lines, proportionally flattened on curves, will probably be sufficient to command the country to be crossed, and combine utility with economy, in a proper degree.

In all our railroad surveys, (for the sake of convenience) the changes of grade have been made *at points*, without rounding the angles formed—but in the construction of the work, these angles, (wherever the changes are abrupt, as between 50 feet per mile *ascending*, and the same *descending*,) should invariably be rounded, and the grades united by vertical curves, tangent to both, and swept with a radius equal at least, to the minimum of horizontal curvature.

All our lines have been traced with the common surveyors compass, (an instrument of great convenience, and expedition, in fitting the lines to the ground,) they will therefore have to be re-traced with a transit, at least upon the tangents, in order to insure a verification of their alignement, as well as to correct the slight errors, to which the compass is liable from diurnal variation.

The dimensions of the grade assumed in all our estimates, are, in embankment 15 feet top, and 1 ½ to 1 slopes—in earth excavation the same base, and the same slopes.

This breadth of 15 feet, in cuts, is rather less than is desirable, but as all the long cuts, are upon strong grades, it will be quite sufficient in the first instance, and can be gradually increased in the reparation of the banks, and in clearing the ditches, after the road is in use, without imposing the necessity of an augmented outlay, at the present moment.

In rock cutting the slopes have been fixed at ⅛ to 1.

In shallow earth cuttings, (like the majority of those met with in Ohio,) the writer would recommend the use of a 1 to 1 slope in construction, as being quite sufficient for the purpose, and producing considerable saving of cost, in some cases.

Capital is so much needed, and so hard to procure in the West, that it behooves the engineer to exercise the most rigid economy, and to limit the dimensions of all his works, to the lowest possible scale justified by sound practical reasoning.

The bridges, running from 25 to 100 feet wide across the streams, where needed upon the line, it is proposed to limit, in span, so that none shall exceed 100 feet in length, clear of support by abutment or pier.

It is designed to sustain them where of small size, by struts from below, while the larger spans would be carried from above by arches, so arranged as to transfer the passing weights to the abutments, in the safest and most secure manner.

Trestle Work, having been shown by the experience of the country, to be merely a temporary expedient, of very questionable propriety—soon requiring conversion into embankment—and dangerous in use upon a passenger road, has been deemed entirely inadmissible on this line, and it has in no case been proposed to resort to this exceptionable contrivance, though the temptation for its adoption (from motives of economy) was strong, at points where material for embankment is scarce.

A deep gorge, is so readily, and (in the first instance) cheaply passed, upon a temporary scaffolding of timber, resting on trestles, somewhat similar to the false works, employed by carpenters in raising bridges, that the inducement to use it, is often great—for the cost of embankment, increases rapidly with its height, while a few feet, more, or less, is not material in the expense of trestle work, if the leading element of risk, and danger, to the public, be overlooked, or disregarded.

The great weight of the modern locomotive, and its train, and the speed now usual upon railways, demand for the safe transit, of passengers and freight—structures of far greater solidity, than were first anticipated by the engineers of this country, and hence it is, that on the older railroads, the heavier bridges are nearly all undergoing a process of strengthening, or have already been strengthened, or even entirely re-built ; while, ***trestle work***, as an integral part of a railroad grade, has entirely disappeared, and may be considered, ***obsolete.***

Lastly, we have considered that a mile of distance saved, would justify an outlay of **$50,000.**

This is the same amount assumed by Solomon W. Roberts Esq., civil engineer, as a governing point, upon the northern Ohio railroad, [the Ohio and Pennsylvania,]—John Edgar Thompson, Esq., Chief Engineer of the Pennsylvania R. R. using **$52,800,** alluded to—and these sums being deemed by the eminent engineers, sufficiently close approximations, for practical purposes.

In concluding this branch of the subject, it is necessary to observe, that the railroad contemplated in this report, is designed to be a single track road only, [like most others in the West,] and that the gauge of the track, is that fixed by the general laws of the state of Ohio—*four feet ten inches, from iron to iron.*

VI. OF THE ROCKY FORK AND PAINT VALLEY LINE.

We have given this designation to the line surveyed from the outer Depot at Hillsborough, by Wolf Run, Rocky Fork, Blinco summit, Mackerly's Hollow, Plum Run, Paint Valley, North Fork, and Hydraulic Canal, to the corporation boundary of Chillicothe, just below the canal bank.

This line leaves the outer Depot at Hillsborough, (which is half a mile west of the town, and 38½ miles by the turnpike from Chillicothe,) rising 28 feet, with a grade of $50\frac{16}{100}$ feet per mile, crosses the Academy point, by a cut of $32\frac{7}{10}$ feet maximum depth, and 2,200 feet in length from grade to grade, passes, with an undulated gradient at the same rate, (falling and rising $11\frac{4}{10}$ feet each way,) over the deep valley north of Judge Price's, formed by Trimble's Branch of Moberly, upon a heavy embankment formed from the waste materials of the rock cuts. and fortunately situated to receive their contents, and finally by a cut of $42\frac{3}{10}$ feet greatest depth, and 1,532 feet extreme length, passes through the ridge north of Wm. H. Trimble's, and fairly enters the valley of Wolf Run.

Thence it continnes down that stream usually high up on the slope of the left bank, crossing the Milford and Chillicothe turnpike, at a distance of $1\frac{4}{5}$ miles from the Depot, for the first time.

Continually descending at the rate of $50\frac{16}{100}$ feet per mile, it falls $179\frac{37}{100}$ feet in a single plane, and gains the Rocky Fork bottoms near the line dividing the Highland County Poor House Farm, from Hogshead's.

Thence by the bottoms of the Rocky Fork, crossing Clear Creek at an elevation of 17 feet above low water, (freshets rising 11 feet,) by a bridge of 90 feet span, and crossing other drains of small size at low elevations, passing through McDowel's, Remington's, Kennedy's Blunt's, Scott's, West's, and Tomlinson's bottom lands, and arriving at Richard Lucas's, in a distance of $8\frac{3}{4}$ miles from the Depot at Hillsborough.

Here the ascent of the Blinco summit is commenced, and overcome by gradients of $50\frac{16}{100}$ feet per mile for 6,885 feet, and $30\frac{62}{100}$ feet per mile for 5,700 feet—total rise $98\frac{46}{100}$ feet—the line passes between the house and mill of John Lucas, and crosses the summit near Scammerhorn's.

The Blinco summit is on the table lands of Highland county, and is the main summit of this route, the grade level here, is $85\frac{4}{10}$ feet *below* the Depot grade at Hillsborough.

From the Blinco summit the line descends to the valley of Puncheon, (crossing the Milford and Chillicothe turnpike a second time,) and passing that stream at an elevation of $22\frac{5}{10}$ feet, between Fletcher's and Brown's, arrives opposite to

Rainsborough, and a little north of the place, in a distance of 12 miles from the Depot.

Leaving Rainsborough, the line passes north of Redkey's, and south of Rhoads', and Widow Upp's, and descends into Plum Run by Mackerly's hollow, a favorable break in its right bank [*where near an old chimney on Mrs. Clagett's land, it unites with the Fall Creek Ridge Line,*] and thence it follows Plum Run, nearly to its mouth, going north of Mrs. Clagett's, (crossing Plum Run twice,) and finally crossing "*the Park*" near the creek, enters upon Hewlitt's land, on favorable ground, and cutting through the promontory at Mackerly's farm, reaches the "*Indian Ford,*" in a distance of a little less than 17 miles, measured from the outer Depot, ½ mile west of High street, Hillsborough.

From the "*Indian Ford*" east, for 18 miles forward, (to the Slate Mill,) the line is now practically straight, consisting of long tangents, joined in every case, by curves of 5,730 feet radius.

The line crosses Paint Creek at the "*Indian Ford,*" at an elevation of 43 feet above the water, (highest freshet raise 16 feet,) by a bridge, upon solid rock foundations, consisting of *two* spans of 90 feet each, and on very favorable ground, passes north of the Rapid Forge Iron Works, south of Alexander Brown's and Abraham Pepple's, reaching Paint Creek again at the "*Big Falls,*" a little south of Mr. Smith's—here it crosses, with the grade 18 feet above water, (the extreme freshets rising only 10 feet,) by a bridge on solid rock foundations, with *three* spans of 90 feet each—the third span being added here, because between the "*Indian Ford,*" and the "*Big Falls,* the Rocky Fork, (a large stream,) unites itself with Main Paint.

The "*Big Falls*" are reached in a distance of 20 miles from the Depot, and from this point the line runs skirting the town of Bainbridge, near Fifth street of the town plat, and some distance east of the town re-crosses Paint Creek, at a point 400 feet north of "*Seymour's Bridge,*" by a bridge of 3 spans, of 90 feet each, upon gravel foundations, and near Mr. Walter Dill's brick house, crosses the Milford and Chillicothe turnpike the third time, and keeps thenceforward, on its southern side.

At Walter Dill's, upon McMaokin's bottoms, we cross Paint Creek *twice*, in a bend, intending to turn it for a distance of 2000 feet, through favorable ground, (where our grade is well elevated above all possible freshets,) and thus avoid the difficulties of the "*Upper Narrows*," and the unnecessary prolongation of the line, which would be required, by curving around them.

Thence the line keeps as close to the turnpike as the ground will admit, running straight to the point of the hill at Mr. Enos Prather's, (where it passes close to the southern edge of the turnpike for a short distance,) here a curve is turned on the radius of 5,730 feet, always employed on this part of the route, and a straight line taken across the bottoms running direct for the northern point of the insulated hill called (Slate Hill,) near the mill of Judge Morris.

This long tangent, 7¼ miles in length, is the longest we have been able to draw upon the ground, on this route, all other parts of it showing obstacles, requiring curvature, before an equal distance could be gained.

This straight line passes south of Allen Cochran's, south of *Bourneville*, and runs throughout its course upon embankment, as far as the Cattail bottoms—it leaves these bottoms at the old distillery, by an ascending grade of 50 feet per mile, and finally gains a field south of Recob's tavern on the turnpike.

Here a small curve is turned to the right, and the line continues straight to Judge Morris's mill, (commonly called the "Slate Mill,) which is gained in a total distance of a little less than 35½ miles, from the outer Depot at Hillsborough.

Upon the long straight line a mile and a half below Bourneville, it is proposed to turn Paint Creek for *one thousand two hundred feet*, through McKenzies' bottoms, where the ground is very favorable for that purpose, and thus reduce the crossings of Paint in this quarter to *two*.

At first we designed to advise turning it also through Scott's bottoms, for a distance of 4,000 feet more—but the apprehensions honestly entertained, and expressed by the neighboring farmers, (friends of the road,) as to the effects upon their land of this simple expedient of engineering, have induced the writer reluctantly to propose two additional bridges, (each having three spans of 100 feet,) and include them in the estimates, making in all *five* bridges estimated over Paint Creek—*three* being enough if the stream is turned, as it certainly ought to be.

The cost of these two extra bridges would more than pay for turning the stream, and securing the railroad bank against its action—the writer has no doubt of the economy and feasibility of the plan, but it is so desirable to avoid local hostility in the construction of railroads, that he has prefered projecting and estimating two additional bridges, in order to obviate, all possible objections, and remove the apprehensions of the land owners, even though groundless.

Our long straight line keeps considerably south of the turnpike, for the greater part of its course—only approaching it, at Mrs. Platter's, where it is still *two hundred* feet off.

From Judge Morris's mill, the line sweeps to the right with a radius of 1,910 feet, crosses the north fork by a bridge of two spans of 90 feet each, and descends the valley by a very direct course, cutting off a small bend at McDill's bottoms—where the stream should be turned for a distance of *one thousand one hundred feet*, to avoid *two* bridges.

It gains the table land at Carson's, below the mouth of the North Fork, by an ascending grade, rising $24\frac{41}{100}$ feet in all, and crossing the Hydraulic Canal at a pond formed at the mouth of the ravine of a little stream descending from McArthur's Hill, continues thence in a straight line generally parallel to the canal bank, and close to it, until the corporation line of Chillicothe is reached, in a distance of *forty and one-third* miles from the outer Depot west of Hillsborough.

The location along the Rocky Fork, and in Paint valley, is necessarily controlled in the position of its grade, by the level of the highest known water—this has been carefully ascertained with the level at many points, and the grade so laid, as always to bring the top of the iron rail at least 2 feet 8 inches above the highest water mark of the greatest freshet ever known.

It is only so low as this, at one point in Cochran's bottoms above Bourneville—being usually 3 feet or more above the highest water.

(For particulars see Appendix **B.**)

That the heights of the top rail above the highest water, shown in our tabular statement, are quite sufficient to render the road perfectly safe, when completed, does not admit of doubt.

There is no grade upon the above described railroad line exceeding $50\frac{16}{100}$ feet per mile and no curve of a less radius than 1,910 feet.

By this Rocky Fork and Paint Valley line, the total distance from the outer Depot grounds at Hillsborough to the western corporation boundary of Chillicothe will be,

By the turnpike modification,............$39\frac{1}{4}$ miles.
" the North Fork and Hydraulic line,....$40\frac{1}{3}$ "

Upon this line as located upon the ground, we have in the vertical arrangement of the gradients, as follows :

Ascent east, from Hillsborough Depot....$286^{\underline{32}}$ feet.
Descent east, " ....$719^{\underline{09}}$ "

Total ascent and descent...............$1{,}005^{\underline{41}}$ "

The terminating grade of our line at the corporation boundary, below the Hydraulic Canal, is $437\frac{3}{4}$ feet below the level of the Depot grade at Hillsborough, and the streets of Chillicothe on the turnpike side of the town, near the western limits of the corporation, are about 407 feet, below the same.

The table below gives the details of the horizontal arrangement of the line, showing of,

Curved line.........................$11^{\underline{11}}$ miles.
Straight " ....$29^{\underline{22}}$ "

Total,..............................$40\frac{1}{3}$ "

Hence 27 per cent. of the line is *curved*, (on radii not less than 1,910 feet,) and 73 per cent. runs *straight*.

While the total of the deflections made equals 1,280°, or $3\frac{1}{2}$ full circles.

HORIZONTAL ARRANGEMENT.

ROCKY FORK AND PAINT VALLEY LINE.

CURVATURE TO 100 FEET.	RADIUS OF CURVE.	TOTAL DISTANCES OF CURVES.		TOTAL CURVATURE.
Degrees and Minutes.	in Feet.	in Feet.	in Miles and Decimals.	in Degrees and Minutes.
3°	1910	30200	5,7178	906°
2°	2865	8325	1,5767	166° 30′
1° 30′	3819	2100	0,3977	31° 30′
1°	5730	17150	3,2481	171° 30′
0° 30′	11460	900	0,1704	4° 30′
Total length of curved line,		58675	11,1107	1280°
Total length of straight line,		154315	29,2263	3½ Full Circles.
Both, straight and curved,		212990	40,3370	

The above table gives the horizontal character of this line as traced upon the ground.

The first location consisted of 22 curves and tangents, the straight lines being the longest and best average lines admitted by the ground, but on examination of the quantities, these lines [the true location nevertheless] were deemed too expensive, and by a free use of 3° curves, the location was modified, to save cost as above :

In this original location, we had of straight line, 171,509 feet.
Of curved line..............................41,058 "

Total,................................. 212,567.

And the total number of degrees of curvature was only 704°, or less than *two* complete circles.

When we arrive with the Paint Valley Line, at Enos Prathers, above Bourneville, a modification of the line has been proposed by the neighboring Farmers, and surveyed by the writer.

This modification runs straight from Enos Prather's to Nelson Prather's, skirting the town of Bourneville, and from Nelson Prather's for a mile or more forward through the lands of John P. Barger, and Mr. McKenzie, runs close along and parallel with the Milford and Chillicothe Turnpike Road, in order to enable the Farmers to enclose both within the same fence.

It then follows along the Narrows, near Mr. Coover's, and passing through Mr. Breedlove's land, south of his house, unites with the Line located at the "*Cattail Bottoms.*"

This modification avoids all the crossing and turning of Paint Creek, on Scott's Bottoms, by keeping constantly upon the left bank, and by adopting it about $11,000 would be saved in the original construction.

It would however contain more grade and considerably more curvature—the Line it would substitute being perfectly straight.

In addition, *it would be one-fourth of a mile longer*, and would run for so long a distance, close to, and side by side with the Turnpike, as to render the use of both Turnpike and Railroad dangerous to the public, at this place.

For these reasons notwithstanding its superior economy, and the probability of more stock being subscribed upon it, the writer cannot recommend its adoption.

While on this branch of the subject, the writer will observe that in locating the Paint Valley Line, he has been careful to avoid running side by side, with the Turnpike, as far as possible, and the Line generally will be found so far removed from it, as to render neither work inconvenient, or in its use, dangerous to the other.

The modification of which the Paint Valley Line admits eastward of the Slate Mill, [Judge Morris's] by taking thence, either the route across the gap through which the Turnpike enters Chillicothe, or the north Fork and Hydraulic canal Line, to the corporation boundary, will be treated of separately, in another place.

In concluding the description of the Rocky Fork, and Paint Valley Line, it is necessary to remark that in consequence of the Highland county portion of it, having been pronounced *impracticable*, it was made by the writer, the subject of an exact location upon the ground, and found to be *not only perfectly practicable, but in fact a highly favorable Line.*

VII. OF THE FALL CREEK RIDGE, AND PAINT VALLEY LINE.

This Line beginning at the outer Depot at Hillsborough, 38¼ miles from Chillicothe by the Turnpike Road, avails itself of the break made by Moberly's Branch, in the western ridge of Clear Creek, and descends the valley of that Branch.

Moberly's Branch falls faster than the grade, which necessarily throws our Line well up on the slope of the right bank.

This fact however, enables us to save some distance, though the expense of the work is somewhat increased.

The Line follows Moberly's Branch, down to the immediate valley of Clear Creek, bending gently to the southward and eastward, until it nears Captain Anderson's, here we take a straight line, about 2¾ miles in length, which passes about 100 yards south of Albert Swearingen's barn, crosses Clear Creek obliquely with the grade, 15 feet above the water, cuts through the ridge dividing Clear Creek from Dickeys Run, at a very favorable point, in the north-west corner of John Nelson's meadow, where the cut will be about 22 feet deep at the highest, and 500 feet long at the base, continuing thence diagonally, straight across Mr. Nelsons farm, crossing Dickey's Run, and the Greenfield road, and finally gains the valley of Shoemaker's Branch, in the field of Noah Evans, a half mile north of his house, and 4 ¼ miles from the Depot at Hillsborough.

Here the tangent line of 2¾ miles ends, and we commence winding up along the western side-slope of Shoemaker's hollow, with easy curves and running generally nearly a grade line, passing not far south of Shoemaker's house, recrossing the Greenfield Road, and finally, in a distance of about 6¼ miles from Hillsborough, gaining a point in the woods north-west of Gordon Pogue's, where the cut necessary to pass the main Summit at Hogshead's begins.

The Summit at Silas Hogshead's, forms the only leading Summit of this route, the others being merely small undulations to save expense.

The line here, passes near Silas Hogshead's barn, and sweeping around the hill [on which Gordon Pogue's farm is situated,] comes upon the intersection of the Greenfield, and Anderson Roads, passing close to Benjamin Beeson's house.

This Summit cut is 4,800 feet long, it has an average depth of 11 feet, a maximum depth of 18 feet, [at a roll in the ground east of the Summit,] and has been computed as though entirely composed of rock.

This Summit at Hogshead's, is gained by a grade of $50\frac{16}{100}$ feet per mile, ascending for about two miles, and rising in all 132 feet.

The ground at its apex, is just 30 feet above the Depot Grade at Hillsborough, and the highest grade point will be 17 feet above the Depot Grade, or 629 feet above low water mark of the Ohio River at Cincinnati, and is just 17¾ feet, lower than the Scioto and Little Miami Summit of the Hillsborough and Cincinnati Railroad.

This is the highest point attained by the grade upon this Railway line.

Leaving the cross roads at Benjamin Beeson's eastward, the line will run straight for about 2½ miles towards the north end of Parker's Hill, passing 100 yards north of Spohn's barn, 1100 feet north of the Quaker Meeting House, 600 feet north of Widow Overman's, about the same distance north of the Dunkard Church, and 500 feet south of Thomas Montgomery's barn, gaining a depression at the north end of Parker's Hill, in a distance of 9⅛ miles from Hillsborough, before finally adopting this trace however, a line should be tried *north* of Montgomery's, which promises to afford a much more economical grade.

This line runs from ⅛th to * a ¼th of a mile north of the Anderson road.

Up to Parker's Hill, the line, is along, or near the Summit of the Fall Creek Ridge, skirting the heads of the drains of Blinco, or crossing them near their sources.

At this point, the line leaving the Fall Creek Ridge by its southern slope, bends a little to the south with a very easy curve, and on a straight line of 2⅛ miles in length, recrosses the Anderson Road, runs diagonally across Absolam Summers's farm—crossing the head of Puncheon—passing about 100 yards north of Mr. Summers's house, crossing at a favorable depression [between Hyatt's and Ravenscoft's Hills,] the ridge dividing Puncheon from Plum Run, and entering the valley of the latter, runs 100 feet south of Philip Rhode's tenant house, about 600 feet south of his dwelling, and gains a small Summit between main Plum Run and its south Fork, upon the farm of Miss Rhode's in a distance of 11¾ miles from Hillsborough.

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* The Anderson Road was laid out at an early day, by the late Col. Anderson, who lived in this State as Land Agent for the Old Virginia Continental Line, and who marked out this Road through the wilderness with the most remarkable sagacity.

The writer has traveled on it at many points between Chillicothe and Cincinnati, and found it almost invariably on the best possible ground.

Here we make a considerable bend to the east and south, and with a straight line about ¾ths of a mile long, pass through the farm of Henry Foreacre, and enter David Houseman's.

Here we make a deflection towards the north and passing very near the Limekiln [a leading topographical point,] we run with a straight line of about ⅞ths of a mile through James Rhode's, 100 yards north of his house, through Mrs. Foreacre's about 400 feet north of the house, and south of Crawford's Mill, gaining a point opposite Crawford's Mill, in a distance of about 13 miles from Hillsborough.

We now bend again to the eastward, and crossing Plum Run three times, [the two latter or eastern crossing's at favorable chasms of rock,] we join the Rocky Fork Line, near an old chimney standing in the main valley of Plum Run at the north of Mackerly's hollow, which the line passing Rainsborough descends.

We gain this point of junction in less than 14 miles from the outer Depot at Hillsborough.

As we come down to this point, with a much lower grade than the Rocky Fork Line, some changes will be required in that Line as far down the Park—eastward of that point the two lines coincide, and become one throughout their length to Chillicothe. The total distances being all reduced—*one mile and a quarter*, by the saving effected by the Fall Creek Ridge Line.

The above Line is merely an approximate location, and will need some revision before the construction is commenced, and the writer regrets the time at his command did not permit the actual trace of an exact location upon the ground.

It will not however differ in any very material point from the Line described above, which was deduced from a trial Line, traced and levelled with great care.

Several modifications of this route near Clear Creek were tested with the instruments, but turned out unfavorably.

A line by James Trimble's, the Greenfield Trace, and Wm. Nevin's Summit, would save about ⅛th of a mile of distance, but its great cost, the height of that Summit, and the difficulty of gaining it from Clear Creek with a grade of 50 feet to the mile, render it impracticable.

Other cut-offs tried upon Mr. Nelson's farm, shared the same fate.

It is probable that some improvements may be made in the Line above described along Plum Run—so as to save perhaps an eighth of a mile of distance, but this can only be determined by elaborate surveys, as the line traced occupies apparently the best ground, though it can doubtless be somewhat shortened—a point of great importance if it can be effected without impairing the gradient on this—our longest plane.

The total distance by this Fall Creek Ridge and Paint Valley Line, when finally located upon the ground will be as follows: Measuring from the outer Depot grounds ½ mile west of the town of Hillsborough, to the western corporation boundary of Chillicothe,

	Miles.
By the Turnpike Modification................	38
" The North Fork and Hydraulic Line........	39 $\frac{1}{12}$

The two points on the boundary, not being identical, but about a mile apart north and south, as will be noticed on the map.

The Air Line from the Hillsborough Depot to Chillicothe, by way of Bainbridge being 36 miles, this route by adopting the Turnpike modification would exceed it only 2 miles, or about 6 per cent.

The Air Line direct to Chillicothe being 35 miles, this route exceeds it only 3 miles, or less than 9 per cent.

The distance by the Turnpike from Chillicothe to the outer

Depot being **38 ½** miles, ***this line is a half mile shorter than the Turnpike Road.*** *

It may here be remarked that the cutting at the end of Parker's hill, and filling across the head of Puncheon, form such leading items in the expense of this route, that a line ought to be tried north of Thomas Montgomery's, in which direction it is believed that Parker's Hill may be completely turned, and the grade kept down so low that Puncheon may be crossed with a light Embankment, though care must be taken, not to make much sacrifice of distance in pursuing this object.

The following table shows approximately the horizontal arrangement this line will have, when located upon the ground in a proper manner.

HORIZONTAL ARRANGEMENT FOR THE FALL CREEK RIDGE AND PAINT VALLFY LINE.

(DEDUCED FROM THE EXPLORING LINE.)

CURVATURE IN 100 FEET.	RADIUS OF CURVE.	TOTAL DISTANCES OF CURVES		TOTAL CURVATURE.
Degrees and Minutes.	in Feet.	in Feet.	in Miles and Decimals.	in Degrees and Minutes.
3°	1910	5480	1,0368	329° 30′
2°	2865	20025	3,7926	400° 30′
1½°	3819	2100	0,3977	31° 30′
1°	5730	18700	3,5416	187°
0° 30′	11460	900	0,1704	4° 30′
Total length of curved line,		47205	8,9401	953°=
Total length of straight line,		159145	30,1432	2⅔ Full Circles.
Both straight line and curves,		206350	39,0833	

It will be seen by this table, that a Railroad, located by the Fall creek Ridge and Paint Valley Line, from Hillsborough to Chillicothe, on the hydraulic side, will have **23** per cent. of its length of line curved with not less than **1910** feet radius, and **77** per cent. perfectly straight.

And that the total of all the angles of deflection turned, will be equal to **953°**, or **2⅔** complete circles.

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* The Turnpike Roads in the State of Ohio, having generally been located by Engineers, and having greater command of Grade than Railroads, are usually remarkable straight; to save distance therefore by a Railroad Line over an Ohio Turnpike, is quite a success in Engineering.

In this line, when located upon the ground, we shall have approximately the following totals of grade.

Ascent East, from Hillsborough Depot,	312	feet.
Descent East, do	744	"
Total Ascent and Descent,	1056	"

The outer Depot at Hillsborough, the western terminus of all our lines, being a half mile west of the town, the distance of 38 miles in which our "*Fall creek Ridge and Paint Valley Line*" gains the town of Chillicothe, is equivalent to 37½ miles, measured from High street, Hillsborough, or *one-half mile shorter than the turnpike*, and two miles shorter than the trial line, formerly reported by Mr. Juques for the people of Paint Valley, which made the distance 39½ miles from High street, Hillsborough.

VIII. OF THE MODIFICATION OF THE PAINT VALLEY LINE, TO ENTER CHILLICOTHE BY CROSSING McARTHUR'S HILL AT THE TURNPIKE GAP.

Arrived at the "*Slate Mill*," (Judge Morris's,) the Paint Valley Line may reach Chillicothe either by crossing McArthur's Hill at the Turnpike Gap, or turning it by the south, and striking the corporation boundary below, and near to the Hydraulic Canal.

The Turnpike line to the corporation boundary, near the Catholic Church, will cost $26,310 more than the Hydraulic line, to the corporate limits there.

But it will save six-tenths of a mile of distance to a through line, the value of which is estimated at $30,000.

In equivalent capital, therefore, the Turnpike line into Chillicothe will be $3690 *the cheapest.*

Practically, then, these two lines may be considered *equal*, in cost and in constructing the Paint Valley line, it would be proper to pause at the "*Slate Mill*," and leave the final location of the Eastern terminus of the line to be determined mainly by ulterior considerations.

ESTIMATE.

Probable cost of Railroad grade into Chillicothe, across McArthur's Hill, by the Turnpike Gap, ...	$47,590
$2.^{\underline{634}}$ miles.	
Probable cost of North Fork and Hydraulic Line, ...	21,280
$3.^{\underline{717}}$ miles.	
Difference, ...	$26,310
Value of six-tenths of a mile of distance saved, ...	30,000
Difference in favor of the Turnpike Line, ...	3,690

In this estimate both lines are computed from near an old log house on Dr. Trimble's farm, where they branched from each other, and the North Fork Line was charged with six-tenths of a mile of track saved, by the other.

These estimates include every thing but the Railroad Track, which is omitted in both.

It must be observed here, however, that the Turnpike modification involves the ascent of about 35 vertical feet more of grade than the North Fork line, but the importance of gaining the town plot of Chillicothe, in a manner, and at a point satisfactory to a majority of her people, is so great that this additional rise should not be thought an insurmountable obstacle, if other things are favorable.

Equated for grade, we know that *technically* the line to the Hydraulic side is decidedly the best, the other however being nevertheless a good line, the ultimate decision of this point may well be left, to be finally determined by the directors of the company who may build it, and who will doubtless have before them all the considerations necessary for a correct decision.

IX. OF THE ESTIMATES OF PROBABLE COST.

The estimates here submitted are made out to cover Clearing, &c., Grading, Masonry, Bridging and Ballasting: *in fact every thing but the track*, which, at the estimates lately made in this part of the State of Ohio, will amount to $6,000 per mile.

The quantities of the various kinds of work have been computed with care, and the prices applied, (taking in view the difference of circumstances,) average about 20 per cent. higher than similar work, upon the Hillsborough and Cincinnati Railroad, has actually cost.

The prices of this work, executed in the immediate vicinity, have been deemed to afford a safer, and better guide, to determine the probable cost of the work under consideration, than those deduced from experience elsewhere.

There are but two lines which come into competition with each other, between Hillsborough and Chillicothe, as our surveys have shown.

The probable cost of the graduation of those, ready for the track, is as follows:

Each being estimated from the Depot at Hillsborough to the western corporation line of Chillicothe, the one on the Turnpike and the other on the Hydraulic side.

Rocky Fork and Paint Valley Line from outer Depot at Hillsborough to Corporation Boundary of Chillicothe, Hydraulic side, distance 40⅓ miles. *Grading, Bridging, Masonry &c.. complete,* $297,097

Averaging about $7,372 *per mile.*

Rocky Fork and Paint Valley Line, from outer Depot at Hillsborough to Corporation Boundary of Chillicothe, near Catholic Church, (if the Turnpike modification should be adopted,) distance 39¼ miles. *Grading, Bridging, Masonry, &c., complete,* $323,407

Averaging about $8,250 *per mile.*

Fall Creek Ridge and Paint Valley Line, from outer Depot at Hillsborough to Corporation Boundary of Chillicothe, Hydraulic side, distance 39 one-twelfth miles. *Grading, Bridging, Masonry, &c. complete,* $305,210

Averaging about $7,669 *per mile.*

Fall Creek Ridge and Paint Valley Line, from outer Depot at Hillsborough to Corporation Boundary of Chillicothe, Turnpike side, near Catholic Church, (if the Turnpike modification should be adopted,) distance 38 miles. *Grading, Bridging, Masonry, &c. complete,* $331,520

Averaging about $8692 *per mile.*

Cost of the Turnpike modification *greater* than the North, Fork, and Hydraulic Line. $26,310

X. COMPARISON OF THE LINES TRACED TO ASCERTAIN THE ONE TO BE PREFERRED.

There are only three main Lines, which upon survey seemed to require examination by the writer.

These three Lines are only separate in Highland County, all uniting near the Eastern border of Highland, and proceeding thence to the Eastward, by way of Paint Valley—forming but one main Line through the county of Ross.

Of these three Lines, the southern skirts the drainage of the Rocky Fork by the south, on the bottoms of the main stream, and is called "*the Rocky Fork and Paint Valley Line*,"—the northern flanks the Rocky Fork drains by the north, and is called "*the Fall Creek Ridge and Paint Valley Line*,"—the middle one strikes boldly across the country by the towns of Boston and Rainsborough, forcing its way transversely over the drains of the country; we call it for distinction, "*the Boston and Paint Valley Line.*"

This last Line cutting across the country by Trimble's and Brock's Summits, and the towns of Boston and Rainsborough, is the shortest of any which can be run from Hillsborough to Chillicothe, but it is defeated by the great expense of its graduation, caused chiefly by the High Bridge required at Clear Creek, and the broken country in that vicinity.

This Line would gain Chillicothe in a distance of 37½ miles, (only 3 per cent. longer than the Air Lines by way of Bainbridge,) it would have less grade and less curvature than any other, but it would cost about $428,000, for its Grading, Bridging, Masonry, &c.

The bridge at Clear Creek, requiring to be about 71 feet high, was deemed wholly inadmissible by the writer upon this route.

This bridge, and this cost, while cheaper routes were open to adoption, rendered this one, so objectionable, that it was abandoned as inadvisable, or impracticable, in this country at this time.

We thus have narrowed down the comparison to "*the Rocky Fork and Paint Valley*," and "*the Fall Creek Ridge and Paint Valley Lines*," the only two admitted by the ground, within reasonable limits of cost.

The leading characteristics of these Lines, have been described in speaking of each, we will now group and compare them in tabular form.

LINES.	To Corporation Boundary of Chillicothe, (Turnpike side,) near Catholic Church.		To Corporation Boundary of Chillicothe, Hydraulic side, near the Canal.	
	Length.	Cost.	Length.	Cost.
Rocky Fork, and Paint Valley.	39¼	$323,407	40⅓	$297,097
Fall creek Ridge and Paint Valley.	38	$331,520	$39\frac{1}{12}$	$305,210
Difference against Rocky Fork Line.	1¼	0	1¼	0
Difference against Fall Creek Ridge Line.	0	$8,113	0	$8,113

We perceive from this table that the Fall Creek Ridge Line, will be the most expensive in original outlay by $8,113, but as it saves 1¼ miles of distance—it is cheaper in equivalent capital by $54,387. A mile of distance saved, being valued at $50,000.

	Length of Line to Chillicothe on Hydraulic side.	Length of Straight Line.	Length of Curved Line.	Degrees of Curvature turned.	Ascent East.	Descent East.	Ascent and Descent.	Length of Line to Chillicothe, near Catholic Church.
Rocky Fork and Paint Valley.	40⅓	29.22	11.11	1280°	286	719	1005	39¼
Fall Creek Ridge and Paint Valley	$39\frac{1}{12}$	30.14	8.94	953°	312	744	1056	38
Difference against Rocky Fork.	1¼	0.92	2.17	327°	0	0	0	1¼
Difference against Fall Creek Ridge.	0	0	0	0	26	25	51	0

From the above table, it will be seen that in all the engineering attitudes, (except a few feet of rise and fall,) the "*Fall Creek Ridge Line*" is superior to the "*Rocky Fork Line.*"

The small difference of grade against the former, could be reduced upon an exact location, and perhaps extinguished entirely.

The Engineering facts being against the "*Rocky Fork Line,*" it ought to be set aside, and the writer therefore in accquitting himself of his duty, feels constrained to recommend decidedly, the adoption of "*the Fall Creek Ridge and Paint Valley Line,*" as forming the best Railroad route afforded by the ground between Hillsborough and Chillicothe.

The only open question now—is the Turnpike modification—and that for obvious reasons ought to remain open—it affects in nowise the Engineering character of the Line, which will be a good one, either by the Turnpike or the North Fork.

All other things being equal however, the writer would not hesitate to give his voice in favor of the Turnpike modification—having long and closely considered this branch of the subject in all its bearings—it is scarcely the best Engineering line—*indeed it is clearly not so*, but the importance of striking so important a point as Chillicothe in a suitable manner, and approved by her people, would properly outweigh many other considerations, and leaves this peculiarly, a question for determination, by a board of Directors.

XI. OF THE HILLSBOROUGH AND CINCINNATI RAILROAD.

To bring up, in this Report, the description of the East and West thoroughfare across the Southern counties of Ohio, from the city of Cincinnati eastward as far as Chillicothe, the following brief account of the Cincinnati and Hillsborough Railroad, (now under construction) is respectfully submitted:

The information given below was collected, in part, by a personal examination of the line, in company with the Chief Engineer, (C. D. Jaques, Esq.,) and completed from written Statements, furnished by that officer. The Road is graded for *a single track only*, and of the grading and masonry more than three-fourths are finished at the present moment; the superstructure of the bridges is under contract, and will be completed in the course of the coming summer. The iron rails for the whole line, of the same pattern as those of the Ohio and Pennsylvania Railroad, well shaped edge rails, of 60 lbs. weight per yard lineal, have already been purchased through a responsible New York house; 850 tons are now at sea, on the passage from Wales, and the balance will be delivered early in the summer at the port of New York, and brought forward by way of the Lake, and the extension of the Little Miami Railroad to the Western terminus at Lovelands, 23 miles from Cincinnati; for this, the financial arrangements are already made.

Here the laying of the track will be commenced on the arrival of the first invoice of iron, and proceed eastward until the outer Depot at Hillsborough is gained.

Nearly all the cross ties and mud sills (where the latter are to be employed) are already delivered and piled up near the line.

The spikes and wrought-iron chairs are in progress at Cincinnati. In fact, nothing appears to have been omitted that is necessary to put this road in running order early in the autumn of the present year.

By the month of October, with a very moderate degree of exertion, the cars may be run direct from Cincinnati to the town of Hillsborough, (60 miles,) and so much of the east and west line—about one-third of its entire length in Ohio—will then be put in action.

As this line of Railroad will probably be worked by the Little Miami Railroad Company, with their own machinery, under an equitable arrangement for that purpose, no provision need be made at present, by the Hillsborough and Cincinnati Company for stocking their Road.

Leaving the Hillsborough Depot, westward, the line runs on favorable ground and gradually ascending, until the main summit, dividing the waters of the Scioto and Little Miami, is gained at a distance of less than five miles.

Thence sweeping to the north, upon long, straight lines and easy curves, by the small towns of Lynchburgh, Westborough, and Blanchester, it occupies, for the most part, a very favorable table land, and crossing the drains of the East Fork of the Little Miami, at moderate elevations, it reaches the head of Spence's Branch of the O'-Banion Creek; From numerous surveys, this branch has been shown to afford the cheapest, most direct, and in all respects, the most feasible descent from the table lands of any of the tributaries of the Little Miami.

From a point near Hillsborough, to Spence's corner, a distance of more than *twenty miles,* a perfectly straight line was practicable, saving a half mile of distance, and at little, if any greater cost, but, after much consideration, it was not adopted by the Company.

The line selected, consists of long, straight lines, joined by easy curves; and in point of running time will be found equivalent to a straight line, though of course, somewhat longer.

A reference to the accompanying map will illustrate this.

From the head of Spence's Branch the line descends that stream to the O'Banion Creek, with no grade over 50 feet per mile, (and but little distance upon that maximum,) and thence by the Valley of the O'Banion to Loveland, where it joins the Little Miami Railroad.

LENGTH OF THE LINE.—The length of this Road from Cincinnati to Hillsborough, is made up as follows:

	Miles.
From Cincinnati by the Little Miami Railroad, to mouth of O'Banion, at Lovelands, ...	23.
From Loveland's by the Hillsborough and Cincinnati Railroad to Hillsborough	37⅛
Total by the present Lines, from Cincinnati to Hillsborough	60⅛

By means of some very important improvements now making—or about to be made by the Little Miami Company, in their Road between Lovelands and the City, this distance from Lovelands to the Cincinnati Depot, will eventually be reduced to * .... 22¼ Miles.

Add Hillsborough and Cincinnati Railroad	37⅓	"
Total, ------------------------------------	$59\frac{7}{12}$	

Say 59½ Miles, total distance by the present Railroad Lines, (improved as they soon will be,) from Cincinnati to Hillsborough. (See Appendix C.) or from Hillsborough to Columbia Landing, on the Ohio River, but 56 miles.

The Hillsborough and Cincinnati Company, have recently pushed a survey into the paved limits of Cincinnati, by way of the valleys of Sycamore and Duck Creeks, by which they can gain a Depot in the heart of the City, in a total distance of less than 56 *miles* from Hillsborough, by the route lately surveyed.

It may ultimately be advisable at a future day, to construct this Road into Cincinnati from the north, by the route referred to, in order to save over 4 *miles* of distance, and obtain a more advantageous Depot site for passenger use.

But as this requires the construction of about 18 miles of new road, extending for part of the distance, over broken and expensive ground, it would scarcely be good policy to undertake it at present, or before the supposed inadequacy of the Little Miami Road, to accomodate the new business thrown upon it, shall be actually demonstrated by practical results.

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* By means of these improvements, the Grades and Curves of the City, end of the Little Miami Line, will be very materially improved, while the Embarrassments attending the present entrance into Cincinnati, through the populous suburb of Fulton, will be almost wholly obviated.

Besides—this Line as traced, will have no Depot connection with the River, or with any other Railroad than the Little Miami; these are most serious, if not fatal objections to it.

Horizontal Arrangement.—The following statement, shows the leading characteristics of the plan, or horizontal trace of this Line of Railroad.

TABLE OF CURVATURE.

Curvature to 100 Feet in Deg. and Min.	Radius of Curvature.	Length of the Curves.		Total Curvature in Degrees and Minutes.
		Feet.	Miles and Decimals.	
5°	1146	1200	0.228	60°
4°	1433	4105	0.778	164° 12′
3° 45′	1528	1300	0.250	48° 45′
3° 40′	1563	625	0.118	22° 55′
3° 30′	1637	2763	0.524	96° 42′
3° 07′	1838	700	0.133	21° 49′
3°	1910	4285	0.812	1281 33′
2° 45′	2086	1963	0.372	54°
2°	2865	3580	0.679	71° 36′
1° 52′	3070	473	0.080	8° 50′
1° 30′	3820	1544	0.293	24° 10′
1°	5730	5617	0.065	56° 10′
0° 30′	11459	1500	0.284	7° 30′
Totals of Curved Line,			5.616	764° 12′
Total of Tangents or Straight Line,			31.717	✓
Whole Length of the Road,			$37\frac{1}{3}$	✓

From this statement, it will be perceived. that of the whole length of the Road, ($37\frac{1}{3}$ miles,) 85 per cent. is perfectly straight, and 15 per cent. is curved with various radii; the maximum radius being 1,146 feet.

Vertical Arrangement.—The grades of this road have been made to fit the ground, with the greatest attention to economy.

They are therefore short, and numerous, while the gradients have been made to undulate, (within the limits of the maximum adopted,) whenever the cost of construction could thereby be diminished.

The steepest gradient facing *west*, or ascending towards Hillsborough, is $50\frac{16}{100}$ feet per mile, and this grade runs entirely through the 5° curve on the O'Bannion.

The steepest gradient facing *east*, or ascending towards Cincinnati, is $31\frac{68}{100}$ feet per mile.

The base of the level, employed upon the road is an imaginary plane $98\frac{1}{2}$ feet below the grade at Loveland's, (the junction,) or 51 feet above low water mark of the River Ohio at Cincinnati.

The Depot at Hillsborough is 612 feet above low water mark at Cincinnati, and the summit between the Scioto and Little Miami, where crossed by this road, is 647 feet above the low water aforesaid, or 35 feet *above* the Depot grade.

Total *ascent* of gradients from Loveland's (junction,) to the outer Depot grade at Hillsborough, ...	$612^{\underline{70}}$	feet.
Total *descent*	$150^{\underline{70}}$	"
Total *ascent* and *descent*, ...	$763^{\underline{40}}$	"

From the above statements it will be perceived that some ascended height is lost by the undulations demanded by economy, but not more than would be expected from the ridges and valleys necessarily crossed by the line.

EARTH WORK.—The earth work of this road consists of light cutting and filling of earth, with a small portion of rock in side cutting along the O'Bannion Creek.

The excavations and embankments, (measuring both,) on the entire line amount to about 600,000 cubic yards—$\frac{3}{8}$ths of the whole consisting of cutting, and $\frac{5}{8}$ths of filling.

The average cost of this work has been:

Excavation per cubic yard, ------------------	$8\frac{6}{10}$	cents.
Embankment " ------------------	$9\frac{14}{100}$	"
Rock, (Blue Limetone,) " ------------------	40	"

MASONRY.—The masonry of this road consists of:

Arched Culverts now built, 3 of 8 feet span, 24 total span.
" " 1 of 16 " 16 "
" required hereafter at points where on account of difficulty in procuring stone, *trestle work* will be temporarily used,
1 of 8 feet span, ---------------------- 8 total span.
1 of 6 " ---------------------- 6 "
1 of 30 " ---------------------- 30 "
1 of 4 " ---------------------- 4 "
In all, 8 culverts, ---------------------- 88 total span.

These arched culverts have cost at an average, about *three dollars* per perch of 25 cubic feet.

SQUARE DRAINS, of openings, from 1×1½ feet to 2×3 feet, built of dry rubble masonry, and containing in all about *one thousand six hundred* perches, have been, or are about to be put in upon this road.

Actually finished, ----------------------	1,200	perches.
Yet to be built, ----------------------	400	"
Total, --------------------------------	1,600	"

The average cost of these dry drains has been \$$1\frac{84}{100}$ per perch of 25 cubic feet.

Bridge Abutments.—There are upon this road, besides several stock passages and other small bridges, 21 bridges of spans from 24 to 80 feet, some of the larger ones having piers between the abutments.

These abutments have been proportioned in thickness at base, equal to from $\frac{2}{5}$ths to half their height, and have a top thickness of from 4 to 6 feet.

They are built of limestone taken from quarries producing regular layers, which have in the laying been sized into courses, forming very fair coursed rubble work.

The abutments are laid in full mortar, and the piers invariably in hydraulic cement.

The abutments are offsetted front, and rear at their foundations, so as to secure their bases properly—they are all finished off at 4 feet below grade—and they are 4 to 6 feet thick.

The highest abutment is only 16 feet high clear of the water of the stream.

The average cost of the bridge abutments in mortar, has been \$3 per perch of 25 cubic feet.

For the piers the cement was found by the company, and their cost has been \$4 per perch.

These piers are 6 feet thick at top, and have on every side a slope, or batter of 1½ inches per foot rise.

The writer examined with care the masonry built upon this railroad, and observed no trace of yielding except in the wing walls of a single culvert, which the engineer explained had inadvertently been filled behind with frozen material.

All the masonry appears to have been proportioned by the same rules which have governed similar structures on some of the most important railways in the country.

Bridge Superstructure.—The following list shows the number and aggregate span of the bridges upon this road:

	Number.	Feet lineal of span.
Over O'Bannion Creek, ...	5	649
" Grog Run, ...	1	62
" Spence Creek, ...	9	462
" Turkey Run, ...	1	35
" West Fork, Miami, ...	1	60
" Glady Run, ...	1	40
" East Fork, Miami, ...	1	75
" Turtle Creek, ...	1	50
" Dodson's Run, ...	1	24
Totals, ...	21	1,457

The spans run from 24 to 80 feet, clear width.

The larger bridges will be arched with heavy arches, aided by a well-framed truss, upon the excellent plan commonly called the "*Burr bridge.*"

The smaller bridges will be securely supported, either by heavy truss work from above, or strutting from below—offsets having been left in the masonry for that purpose.

These bridges have been planned with due attention to strength and safety, and the plans having all been laid before the writer, and closely examined by him, he feels able to speak with some certainty on this point.

The heavier bridges all stand upon foundations of solid rock.

Trestle Work—Owing to the want of suitable materials near at hand, for the embankment and masonry, at Mrs. Chamberlain's, Bee Run, First Creek, and Scofield's, the engineer has proposed to put in temporarily 558 lineal, of trestle work.

This trestle work is judiciously planned, and properly braced, and being regarded and intended only as a temporary expedient, to be substituted immediately by solid earth work and masonry, it is less objectionable than it would otherwise have to be considered.

Side Tracks.—The extent of side tracks intended to be laid down immediately, and all with the iron edge rail, is as follows:

At Hillsborough,	1,000	feet.
" Lynchburgh,	800	"
" Westboro'	600	"
" Blanchester,	800	"
" Loveland's,	1,000	"
Total,	4,200	"

Depot Grounds.—For Depot purposes the Company have acquired the following property:

At Hillsborough, Inner Depot,	2½	acres.
" Outer "	8	"
" Lynchburgh Depot,	4	"
" Westboro',	3	"
" Blanchester,	6	"
" Loveland's,	4	"
Total,	27½	acres.

In laying out the Depot grounds, the rule has been adopted of giving them the form of a parallelogram, or oblong square, their length along the track being, (at least,) double the breadth.

Water Stations.—It is intended to establish Water Stations at the following points:

At Hillsborough,	0	miles.
Lynchburgh,	10	„
Blanchester,	11	„
Spencer's Corner,	9	„
Loveland's,	7⅛	„
	——	„
Total,	37⅛	„

This road generally following high ground, will not probably be able in many cases to avail of running water for the service of its water stations, but can readily command hydraulic power to the extent necessary for its purposes.

Graduation Complete.—The entire cost of the clearing, grading, and bridging of this Road, (now four-fifths finished,) is about as follows:

Grading	$63,500.
Masonry	" $29,250.
Bridging	" 17,000.
Total cost of 37⅛ miles of Graduation ready for the Track,	$109,000.

or less than $3,000 per mile for preparing the Road-bed, to *receive* the Track, including all charges for contractors work, but exclusive of Engineering, Superintendence, Land damages &c.

The Railway Track.—The Track of this Road, (4 feet 10 inches wide, agreably to the general laws of Ohio,) will consist of an iron edge rail, of 60 lbs. weight per yard lineal, rolled in Wales, from the pattern of the Ohio and Pennsylvania Railroad—and costing delivered along the Track, about $50 per ton, all charges paid.

This Rail will generally be laid upon white oak cross-ties, (2 feet from centre to centre) 8 feet long, and 6 by 7 inches at the smallest end.

For about half the length of the Road, these cross-ties will rest upon sub-sills 3½ by 10 inches, though it would be much better if practicable, to omit the sub-sills, and depend wholly on cross-ties and gravel ballast.

For a short distance, it is intended to lay the rails upon a Plank

Road 4 inches thick—this is a vicious plan—it would have better been omitted—and it may yet be laid aside.

The joints of the Rails are intended to have beneath them, wrought iron chairs, of ½ inch thick, similar to those used upon the Little Miami Railroad.

Owing to the difficulty of procuring gravel along this line, it is intended to be laid at first *without* ballast, leaving that important part of the superstructure to be finished by the aid of the Track itself.

In this condition without ballast, this Track is estimated by the Engineer, to cost $6,000 per mile.

PROBABLE COST OF THE ROAD COMPLETE.—When this Road shall be completed, exclusive of rolling stock, (which will probably be furnished by the Little Miami Company,) the following will probably be the result.

Grading, Bridging, &c. ready for the Track	$109,750.
Track without ballast, (including side Tracks,) 38¼ miles at $6,000,	229,500.
Add Interest, Land, Damages, Depots, Water, Stations, Ballast. &c. say	60,750.
Probable Cost in round numbers of the whole Road, 37⅓ miles long,	$400,000,

or including all charges, about $10,992 *per mile.*

This Road is probably one of the cheapest in the United States, and promises ultimately, to be one of the most productive.

Part of the great thoroughfare line across Southern Ohio, and at the Cincinnati end of it, with an invested capital so small that a net revenue of only $24,000, will pay 6 per cent. interest on the whole of it; this company occupies a truly commanding and profitable position.

This Road runs for its entire length, through the Blue and Cliff Limestone formations, passing a district of country not yet much subdued by the hand of agriculture, but yielding rich returns, wherever it has been properly cultivated, and promising eventually, to be one of the finest farming districts in the State of Ohio—a district where one year wtth another, crops of large or small grain, or grass may be raised with as much certainty, as in any other.

This Road, now far advanced towards completion, has been conducted in the Engineer Department, by Charles D. Jaques Esq., Chief

Engineer, to whom, and to his able Assisiant, Wm. R. Arthur Esq., Civil Engineer, a high degree of credit is due, for the judicous arrangements, and management, which have led this work forward to such an economical, and successful conclusion, as it now promises to have.

The Hillsborough and Cincinnati Railroad Company, having recently obtained from the Legislature of Ohio, a most valuable grant, in addition to their Charter, giving them power to extend their Railroad eastward, either to Chillicothe, or the Ohio River—and to make branches anywhere in the State of Ohio—occupy a leading, and important position, in the Railroad system of this State.

They have recently decided to extend their Road by the Paint Valley Route, to Chillicothe; and that decision was undoubtedly dictated by the soundest views of policy.

For of the East and West Line, across Southern Ohio, by far the cheapest, and busiest, and therefore the most profitable part of the Road, will be that portion between Chillicothe and Cincinnati.

While by the adoption of this route, they secure forever the passage of the thoroughfare Line, through the town of Hillsborough, which otherwise might not be a point in that great Line of Railway.

This Line too, affords the best possible means of collecting, and drawing to the through line, the trade of the rich Agricultural districts in the northern part of Ross county, for it is only necessary to throw off cheap branches upon the Lines indicated by nature, to effect that object.

A branch by way of Main Paint Creek, would reach the town of Greenfield, in a distance of about 8 miles from the "*Indian Ford,*" at a cost of only $90,000, including the track.

And a branch of near the same length, and at no greater cost, would by the valley of the North Fork, gain the town of Frankfort.

These branches, if the people of those towns, were sufficiently versed in Railroad affairs to know their true interests, would benefit them both to a much greater degree, than the mere passage of a through Line near them.

For as the heads of Branch lines, they would become the true centres of business for the country around them. while with a through Line near them, they would have to divide that business with other Depots, (more convenient in point of distance, to a large body of their customers,) which would certainly be established at intervals of about 5 miles apart, along the main Line.

Common sense, and all Railway experience, indicates the truth of these observations, and they are now thrown out with no other desire, than that the parties interested, may profit by them.

XII. OF THE RAILROAD SURVEYS HITHERTO MADE BETWEEN HILLSBOROUGH AND CHILLICOTHE.

The first Railroad Survey between these points was executed about fifteen years ago, under the authority of the State of Ohio, by David Scott, Esq., Civil Engineer, who was commissioned by the State to survey a Railroad route from Chillicothe to Cincinnati.

This Survey, westward from Chillicothe, pursued the valley of Paint Creek, Plum Run and the Fall Creek Ridge, finally following up Clear Creek, and leaving Hillsborough to the South.

From this Survey no action resulted. In 1844, B. H. Latrobe, Esq., Chief Engineer of the Baltimore and Ohio Railroad Company, came to Ohio, under instructions from his Company, and made a reconnoissance of the whole line of the east and west Railroad projected across the Southern counties of this State, from a point opposite the mouth of the Little Kanawha, to the city of Cincinnati.

Mr. Latrobe selected the leading valley of Paint Creek, as the proper route for a Railway, west of Chillicothe.

On the 8th of March, 1845, "*The Belpre and Cincinnati Railroad Company*" was chartered by the Legislature of Ohio.

Upon this Company, by the 1st Section of its Charter was enjoined the adoption of "*the most practicable route,*" and to enable them at any time to correct an error of judgement, in deciding upon a route, Section 9, conferred upon them an unusual power, adapted apparently with the most remarkable foresight, to meet a case which has since occurred.

In this 9th Section, it is provided,—"that, if said corporation, after "having selected a route for said railway, find any obstacle in continu-"ing said location, either by the difficulty of construction, or procuring "the right of way at reasonable cost, *or whenever a cheaper and better* "*route can be had,* it shall have authority to vary the route and change "the location."

Under the authority of this Company, in the year 1848, a Survey was made from Chillicothe to Hillsborough, by Wm. H. Price, Esq., Civil Engineer, (then Chief Engineer of the Belpre Company.) Mr. Price, like all the other engineers, adopted the leading valley of Paint Creek for the route, but did not survey it through the county of Ross, owing to want of time, and the manifest feasibility of that part of the line.

His instrumental Survey was begun at the "*Indian Ford*," on the Eastern border of Highland county, and continued thence by Plum Run, Fall Creek Ridge, Clear Creek and Moberley's Branch to Hillsborough.

No further action seems to have been had on this subject until 1850.

Then, for the first time, the idea was broached of abandoning the natural route by the direct and favorable valley of Paint Creek, and adopting a location across the country, from Hillsborough, by way of the villages of Greenfield and Frankfort, to Chillicothe.

The writer has been unable to discover who was the original projector of this extraordinary route, but he risks little in saying that the author of it could scarcely have been an engineer, and that *no Engineer*, untrammelled by instructions, would have ever thought of abandoning a leading valley, favorable in its direction and slope, and taking in its stead a forced location across the drainage of the country with a longer line, additional summits, more total grade, and greater cost of construction.

During the whole period of time following the first survey, (from 1836 to 1850, *fourteen years*,) in which public attention had been drawn to this subject, every engineer had adopted the leading valley of Paint Creek, as the proper basis for Railroad lines west of Chillicothe.

All these gentlemen were entirely disinterested, they were well acquainted with the country, and their unanimous selection of the Paint Valley Route, arose simply from their observance of the rules of their profession, which indicated irresistibly the superior advantages offered by that valley.

In 1850, two lines of Surveys between Hillsborough and Chillicothe were executed, under the direction of Charles D. Jaques, Esq., Chief Engineer of the Hillsborough and Cincinnati Railroad Company.

These Surveys were made at the expense, and by the suggestion of the people resident along the respective routes—"*rival lines*" from this period forth.

The most Northern of these lines, by way of Greenfield and Frankfort, is usually called "the *Greenfield line*," the Southern, from the stream which forms its base, "the *Paint Valley Line*."

These Surveys were executed with skill and fidelity by Mr. Jaques but they produced no other result, than an augmentation of hostile feeling, between the friends of each route.

Another engineer, S. R. O'Strander, Esq., Civil Engineer, was now called in to aid Mr. Jaques—a re-Survey was ordered of both the routes, and executed under the joint direction of these gentlemen.

Upon these Surveys a joint report was made by Messrs. Jaques and O'Strander, to a special committee of the Directors of the Belpre Company, under instructions from whom these engineers appear to have acted.

On the information furnished by the engineers, (under their instructions,) this Committee made a report, upon which the Directors decided in favor of the "*Greenfield Line*;" making, by resolution, both Greenfield and Frankfort points in their line, *and equally pledging the faith of the Company to both if to either.*

A. Kennedy, Esq., Civil Engineer, was subsequently appointed Chief Engineer of the Belpre Company, and under his direction the "*Greenfield Line*" has been thoroughly re-surveyed, by a large and active corps of Engineers, who occupied about five months in the work, and examined the country diligently.

The Surveys executed by the writer under the direction of B. H. Latrobe, Esq., Civil Engineer, and now reported upon, form the last of the long series of Engineering examinations, to which this district of country has been subjected.

A necessary consequence of the numerous examinations, in this section of country has been to indicate precisely what lines are practicable, and to omit none which promised any favorable result—never perhaps has any country been more thoroughly explored, and this good at least must be the result, that every feasible line has been traced or reconnoitered, and ample information to lead to a correct decision, has been laid before the public, by these contestant Surveys.

On entering upon an examination of the merits of these two routes, the air line distances should be borne in mind.

At my request these have been computed by C. D. Jaques, Esq., Civil Engineer, who is in possession of accurate Surveys of all the routes, made under his own immediate direction.

[See Appendix **D.**]

They are as follows—measuring always from the outer depot at Hillsborough, to the same point on the Northern boundary of Chillicothe, at the intersection of High Steeet opposite to a bridge over the Ohio and Erie Canal.

From Hillsborough to Chillicothe by Greenfield and Frankfort	38.54
Hillsborough to Chillicothe, by Greenfield only	37.39
Hillsborough to Chillicothe, by way of Bainbridge, [Paint Valley Route,	36.05
Hillsborough to Chillicothe, direct,	35.01

Measured to the West centre of Chillicothe, near the Catholic Church, the air line from Greenfield, &c., would be increased near half a mile, while the direct air line and that by Bainbridge would be but little affected.

From the above it will be observed that the air line difference between the Greenfield and Frankfort, and Paint Valley lines is about two and a half miles in favor of the latter.

With the same outlay of capital on each line, the air line differences would be more than maintained by a Railroad location—if one were shortened by increased outlay, the other could be equally diminished at the same cost, and the advantage of the Paint Valley line would remain undiminished, or increased.

Indeed, the writer has explored, and for the most part actually traced with instruments, a Railroad line, which would reach Chillicothe from the Hillsborough depot, in a distance of thirty-seven and one-third miles, at less expense than that recently estimated by Mr. Kennedy for the Greenfield line.

This line would pass Clear Creek, the greatest obstacle, with a high bridge, (yet neither so high nor formidable in its character as the Rattle Snake crossing) but though it would be a full mile shorter than the Greenfield and Frankfort air lines, if measured to the same point in Chillicothe, and unequalled by any line in which Greenfield formed a point, the writer cannot recommend it, because in his opinion the object would not be commensurate with the cost.

But these air line discussions, however much in favor of the Paint Valley lines, have little practical utility except to establish *minima of distance*, and point out the limits, below which the lines by no contrivance can be shortened.

The true question always is, upon what route between two points given, can a Railroad be made with the least cost, least distance, the most favorable grades and curves, and the least total grade.

To this question, the writer hopes he has already furnished a satisfactory solution, in this report—if that line should not be availed of now that its merits and cost are fully developed, it will only add another to the multitude of examples in human history, of the perversity of our race.

We will now return to the comparison made between the Greenfield and Paint Valley lines, on the 21st of May, 1850; on which a decision was erroneously made against the latter, upon the supposition that it was the more costly by $24,904.

The writer has before him a correct copy of the estimate of Messrs. Jaques & O'Strander, which formed the basis of the deceision referred to.

These estimates in view of the ends they were made to subserve by the special committee of the Belpre Company, furnish some singular results when analyzed, as the following statements will show.

QUANTITIES OF MATERIALS TO BE MOVED ON THE TWO COMPETING LINES.

ITEMS.	GREENFIELD LINE.	PAINT VALLEY LINE.	PAINT VALLEY LINE.	
			Less.	More.
	Cubic Yards.	*Cubic Yards.*	*Cubic Yards.*	*Cubic Yards.*
Rock,	32,951	54,038		21,087
Earth,	496,106	354.491	141,615	
Embank't,	1,137,810	956,052	181,758	
Total of all materials,	1,666,867	1,364.581	323,373	21,087
			Paint Valley less, 302,286	

Of the aggregate of all the materials to be moved, the Paint Valley Line had 302,286 cubic yards or eighteen per cent *less* than the Greenfield Line, and the cost of these materials to be moved was estimated at only $5,135\frac{28}{100}$ less.

MASONRY AND BRIDGING.

ITEMS.	Greenfield Line.	Paint Valley Line.
Masonry,	27.987 .50	39,982 .50
Bridging,	14,458	23,104
	42,445 .50	63,086 .50
PAINT VALLEY MORE,	$20,641	

The Masonry and Bridging was estimated to be *more* on Paint Valley, by $20,641.

RAILWAY TRACK.

ITEMS	Greenfield Line.	Paint Valley Line.
Track	274,731 .51	277,256 .51
Paint Valley less.	$17,475	

The cost of the track was estimated to be *less* on Paint Valley by $17,475.

A comparison of these differences will still show a small advantage in favor of the Paint Valley Line.

We now come to the most curious part of these estimates, the part which turned the scale against the Paint Valley Line, and which appears to furnish the key to the manner in which the balance was worked out against that route.

These are, the *subsequent additions,* which upon the face of the estimates appear to have been made, after the totals were ascertained, and found to be unsatisfactory.

SUBSEQUENT ADDITIONS.		
Items.	Greenfield Line.	Paint Valley Line.
Raised Grade on Bottoms.	5845^{51}	14,295^{16}
Raised Bridges,	0	4 322^{34}
Slate Rock,	0	4,277^{70}
Protection,	3000	10,560
Totals,	$8845^{51}	$33,455^{20}
Difference against Paint Valley.	$24 609^{69}	

Of these, *subsequent additions,* added with a heavy hand to "*the Paint Valley Line,*" and but sparingly applied to "*the Greenffield Line,*" apparently to maintain a show of fairness, and yet give the result desired—it is a singular fact, that one deducted from the other gives a difference against the Paint Valley Line of $24,609, while the balance found against it by the committee, in a different process, was $24,904 *almost precisely the same.*

These additions were alleged to have been made in consequence of the great freshet of 1850, having submerged the grade planned for the Paint Valley Line, but one of the engineers, who personally examined the route, with that object, immediately after the freshet, has publicly declared, both at the time and since, *that this was altogether a mistake.*

The aggregate cost of grading and masonry, clear of the track, and of a large sum (10 per cent. on all) added for contingencies, both to the graduation and the track, in bulk, was, in these estimates, as follows, with all the additions on.

Item.	Greenfield Line.	Paint Valley Line.
Grading, Masonry, and Bridging.	$\$272,866^{\underline{49}}$	$\$312,981^{\underline{91}}$

Upon this valuation of $272,866, in grading, masonry and bridging, "*the Greenfield Line*" was adopted—a small apparent difference against "*the Paint Valley Line*" being thought sufficient to condemn it, though shown in the same documents to be 2½ miles the shortest—the value of this distance saved being $125,000.

True, the directors of this company may have little known, and less regarded, the value of a mile of distance saved, yet they might well be excused by their stockholders for adopting a wrong route, if proved to be the cheapest in original outlay; provided that fact was first properly established, and their subsequent acts were found consistent with that hypothesis.

Such, however, has not been the fact, for their present Chief Engineer, by the results of his elaborate surveys, published by authority in the Scioto Gazette, on the first of April, has taken from under them even the slender support of consistency in their erroneous action.

For Mr. Kennedy, in his recently published estimates, states, that the graduation, bridging, and masonry of the Greenfield line, clear only of the track, will cost························$431,606

The net estimate of Jaques and O'Strander, (without contingencies added,) upon which these directors decided in favor of the Greenfield Line, put the cost of Grading, Bridging, &c. at·································$272,866

Therefore, "*the Greenfield Line*" will cost more than the directors expected, when they decided to adopt it, by the large sum of ·································$158,740

If contingencies be added to both estimates, and they equally belong to both, if to either, the above difference will only be increased.

Up to the hour of receiving Mr. Kennedy's estimate, these directors had not expended a dollar on the Greenfield line, except for surveys, and they had as yet entered into no engagements for outlaying money there. On receiving this estimate, then, *was it not their duty to pause?*

Should they, in the face of this serious increase of cost, directly shown by estimate, as well as a greater increase probable in construction, have entered into contracts leading to this unnecessary waste of funds?

With what propriety can these gentlemen persist, with an erroneous line, now shown, by their own engineer, to cost at least $158,000 more than either they or their stockholders expected it would—a difference more than enough to swallow up all the stock, specially conditioned for the Greenfield line, leave a handsome balance, and annihilate the leading argument on which this wrong location was made.

They properly decided against the town of Frankfort, on a similar question of cost, though pledged to her by the same resolution that bound them to Greenfield. Why not then pursue, with at least equal propriety, a similar course toward the latter, if they saved for their stockholders $158,000 by the operation?

It cannot even be said, that they wanted legal power to shift their location at any moment, for, as we have before stated, the Legislature of Ohio, with a glance into futurity almost prophetic, foresaw, and provided, in the 9th section of their charter, for just such an error of judgement as the present, and no money having been expended, except for surveys, no contracts for work having been entered into—even a court of chancery could not have found a flaw in their proceedings. Besides, even in their contracts, (it is understood,) a saving clause exists, allowing a suspension of operations at short notice, and without allowance for damages.

This wrong step led naturally to others, until the Belpre Company have now involved themselves in a maze of difficulties, from which they can only be extricated, by a total change of policy.

This change, it is fortunately in the power of the stockholders to effect, and they owe it equally to their own, and the public interests, to bring it about, with the least possible delay.

XIII. COMPARISON OF THE PREFERRED ROUTE WITH THE GREENFIELD LINE.

The portions of the report of A. Keunedy, Esq., Civil Engineer, (the present Chief Engineer of the Belpre Company,) published by authority in the Scioto Gazette, of April 1st, 1851, do not contain all the details necessary to a strict technical comparison of the Greenfield and Paint Valley Lines.

The writer hoped to have been able to publish in this document, a full and accurate copy of that report, but it could not be obtained.*

No doubt these details were all contained in the report of the Engineer, why then withhold from a deeply interested public, the detailed facts necessary to lead their judgments to a correct conclusion?

It is with the express view of laying everything frankly before the people interested, that the writer has prolonged this report to so great a length.

Nevertheless, the report of the Engineer of Belpre Company, furnishes the means of comparison in some of the leading characteristics of Railway lines.

	Distances given by Mr. Kennedy. MILES.	*Air Lines computed by Mr. Jaques.* MILES.
Hillsborough to Greenfield,·······	17.165	16.29
Greenfield to Frankfort,··········	11.610	11.46
Frankfort to Chillicothe,········	11.060	10.79
Totals,···············	39.835	38.54

The distances of Mr. Kennedy (the terminating points of which are omitted in his report) are understood to have been measured to a point within the plat of Chillicothe, about as far below the Northern boundary as the line reported leaves the town of Frankfort, the comparison therefore with the air lines holds good, as though they both began and closed upon identical points.

The surprising closeness with which these Railroad distances correspond with the air lines, will strike every one familiar with the ground—and this will be especially the case between Hillsborough and Greenfield, where the country is known to be hilly and broken.

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* These details were denied, not only to an application made for the writer, but also to a request personally made, by Mr. Latrobe.

The writer in exploring West of the Spohn's farm on Fall Creek Ridge, led his party over the Nevin's summit of the Eastern ridge of Clear Creek, and near John Bunton's fell in with the Greenfield trace, and for the sake of convenience followed it to Clear Creek.

Somewhat surprised at the broken ground it traversed, (ground more rolling than is usually selected for Railroad routes in the West, where the command of capital is limited,) the writer was induced to extend his investigations along Fall Creek, to the Rattlesnake crossing of the "*High Line.*" The stupendous magnitude of the works required at and near the Rattlesnake fork, deeply impressed the writer with the conviction, that this line *was traced rather to be measured in competition than to be built*, and the recent surveys west of Greenfield confirm this view *by abandoning this line.*

In the contest between the competing lines, it was necessary for the Greenfield interest, to make if possible two naturally divergent qualities unite—they wished to have a short line and a cheap one too,—things in themselves usually *incompatible.*

To effect the first, they took "*High Lines*" across the country as birds fly, and expected to accomplish the second by planning the crossing of the deepest chasm, on a very high bridge, the grade line being elevated eighty feet above the water! This bridge alone would cost $50,000, leaving only $129,000 for seventeen miles of heavy grading.

Any one contemplating the vast works needed in this vicinity, and their perilous character—reflecting at the same time that he is in the country of cheap railroads and viewing the line of a Company with very limited means—knowing, too, that a prolongation of the route for one and a half or two miles, would reduce the expense near $100,000, and do away entirely with the fearful structures now projected—would have conviction irresistibly forced upon his mind, that he is looking at a line, that was hardly ever intended to be built, but merely traced in order to get a proximate air line distance measured from Hillsborough to Greenfield, to be subsequently shifted to more practicable ground, in case the line was ever constructed.

We have seen how potent instructions proved to be, in the case of the comparative estimates of Jaques and O'Strander, (for which those engineers may be excused,) and Mr. Kennedy could no more be censured, if under instructions either formal or even intimated, he traced an air line or nearly so, *to be measured in a competition, which his professional judgment could never sanction to construct.*

The writer has such confidence in the professional skill of the Engineer of the Belpre Company, that he hesitates not here, for future reference, to record his firm opinion, that if a Railroad be ever built from Hillsborough to Greenfield, it will not be upon the "*High Line,*" but on the "*Cedar Run,*" or some other line of greater length and corresponding cheapness.

The writer feeling none but a professional interest in this matter, as an Engineer and a friend of the through line, has become convinced from observation, that it never was really the intention of the Belpre Company to make the road from Greenfield to Hillsborough, and certainly never upon the present line reported.

The line itself between these points, has never yet been actually located upon the ground, having where followed by our instruments, been found to contain offsets and angles inadmissible in a line prepared for contract—it was in fact a mere exploring line, run with judgment, and from which a location could be computed, though that location has never been traced upon the ground.

Indeed, at the very time the trial lines were run between Hillsborough and Greenfield, the amendment to their charter conferring power to run direct to Cincinnati from Greenfield was probably in secret contemplation,* though the Belpre Company was at that very moment, engaged in hollow negociations with the Hillsborough Company, for a junction at that place.

This amended Charter is now a law, and though the Belpre Company might desire the public to believe, it was obtained without their knowledge or consent, *it was nevertheless promptly accepted by them officially, and formally adopted as their act.*

Already their engineers, under the new powers conferred, have been sent to seek a route to Cincinnati, by which the town of Hillsborough may be avoided even at the risk of prolonging the through line, by involving it in the sinuosities of the Stone Lick Fork, a route surveyed and rejected some years since.

The Hillsborough Company owe it to the foresight and courage of their Directors that they have escaped the consequences of the measures adopted by the Belpre Company, and occupy now a leading and independent position—one that will give them the through line, if the people and bodies corporate along the route act as their mutual interests require.

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*Under this amended Charter the recent surveys have been made.

COMPARISON OF COST.

Greenfield Line, estimated by the Chief Engineer, to cost for preparing the Road bed ready for the track,....	$431,606
Equivalent capital charged for two miles of distance lost,	100,000
Total..................................	$531,606
Paint Valley Line, ready for the track, including the Turnpike modification [the most expensive line run]····	$331,520
Difference of Cost, direct and equivalent, in favor of Paint Valley Line,··································	$200,086

We now come to take into account the measured distance saved by the Paint Valley route.

The point to which Mr. Kennedy has made his measurements in Chillicothe, is not precisely known, never having been made public, it is however supposed to be not far from the Catholic Church.

Reduced to the same point gained by the writer, the length of the Greenfield line reported on will not differ much in round numbers from forty miles.

We have then between the same terminal points, as follows :

Greenfield Line - - - - - - - - -	40 miles.
Paint Valley Line, - - - - - - - -	38 miles.
Difference in measured distance, -	2 miles.

It is true the Greenfield Line can reduce the cost of their work, and improve its practical character, by lengthening the route upon ground judiciously selected.

But in that case, the measured distance in favor of the Paint Valley Line will be increased to four miles, which at the usual valuation of $50,000 for a mile of distance saved, would be $200,000, thus proving our result by a different process.

The fact is, this result is unchangeable and inevitable, it has been stamped upon the face of the country, by the great Architect of all things, and shape it as you will, run lines as you will, the difference will be found the same against the Greenfield line—$200,000 *greater cost or four miles of distance lost.*

And it must be observed here. that it is only by a judicious prolongation of the line, that it can be made even so favorable.

The best route for a good, practical, working railway, laid out with due regard for economy, from Hillsborough to Chillicothe by way of Greenfield, must have a length of about forty-two miles.

No account is made in these comparisons of the equated distance for the Grade, which may be found in favor of the Paint Valley Line because the published report does not furnish that item for the Greenfield line, with sufficient detail.

XIV. PROSPECTS OF THE EAST AND WEST THOROUGHFARE ACROSS SOUTHERN OHIO.

The Hillsborough and Cincinnati Railroad Company having adopted the Paint Valley Line, and determined to extend their road to Chillicothe, the east and west line across southern Ohio, upon the shortest and best route, will then be brought up from Cincinnati to Chillicothe in a distance of 98 miles, and at a very moderate cost.

In this there will be no difficulty if this enterprising company receive from the city of Cincinnati, and the other true friends of this great work the aid which they deserve.

For this concern the prospects forward are good, they are in the right path, and have only to advance prudently and boldly, to successfully accomplish their object.

Eastward of Chillicothe, however, the writer regrets exceedingly to be compelled to say that the prospects of the through line are at present overclouded—as unfortunately the Belpre company, instead of directing their energies to the construction of the great line *east* of Chillicothe to the Ohio River, a distance of 87 miles—where there are no competitor lines, and no other companies, anxious to assist—are devoting themselves to efforts to double the railroad back upon itself, and after it has been carried forward from Cincinnati to Chillicothe, by the Hillsborough company, to bring it back again by a longer route from Chillicothe to Cincinnati—while the same effort would carry it on to the Ohio, and complete the connection from the latter city to Parkersburg.

A mere statement of these facts is sufficient to denote in advance the opinions that all impartial men will entertain relative to this most extraordinary course on the part of the Belpre company.

In other sections of our country where great lines of railway have been undertaken by companies of insufficient means, they have always courted assistance—*here they repel it when offered!*

Great lines of railway can only be built in countries of limited resources by a thorough business course, by making friends of all, enemies of none, and they never can be forced through a country, but must always win their way.

The fact is unfortunately but too prominent, that the greatest obstacle at the present moment to the speedy completion of the east and west line, is the very agent selected by the people of the southern counties, and indicated by the laws of Ohio, to accomplish that important object.

The present organization of the Belpre company—its present management—forms the root of all the difficulties ahead, and against that a blow should be struck by every true friend of this great enterprize.

Their comparison between the Paint Valley and Greenfield lines, under circumstances but too strongly indicating a foregone conclusion—their decision against the former, on an alleged difference of about $25,000, which had no real existence—their obstinate persistence in error, after their present engineers had proven them to be wrong to the extent of some $159,000, and overthrown by their estimates the whole superstructure of erroneous reasoning upon which that decision was based—though no expenditure of money had yet bound them to the wrong route—though their charter gave them all lawful authority to adopt the true one at any time—and though they did abandon Frankfort, to whom their official faith was equally with Greenfield, pledged. Their negociations and engagements with Marrietta, their surveys towards that town—when the legislation of Virginia and the intentions of Baltimore, had bound the through route to Parkersburg—their worse than useless contests with their Hillsborough friends—their loss of the confidence of Cincinnati by an unusual course of policy, and by schemes, looking to a western connection in another state—their manifest efforts to build up the town of Chillicothe, at the expense of Cincinnati and the southern counties—all evince but too strongly an incapacity in railroad affairs, totally unfitting them for the conduct of such an enterprize as the through line across southern Ohio.

The position of this corporation on the reception of Mr. Kennedy's estimate, should be specially marked—up to that hour they were uncommitted, either by contracts or outlay—that estimate apprized them fully of the inadequacy of all their former calculations—and imposed upon them as a duty, that the resolution making Greenfield and Frankfort points, *being based upon wrong information,* should be instantly rescinded—it was then that they properly abandoned Frankfort for excessive cost, and yet with singular inconsistency, adhered to Greenfield!

Let that company change this suicidal policy, compose the quarrels which have been unnecessarily begun—regain the confidence of Cincinnati—re-unite the friends of the object in all quarters—drop the work west of Chillicothe—push it with energy east of the Scioto—and all may yet be well.

The stockholders owe this change to themselves—the security of their investment being jeoparded—they owe it to the State of Ohio, whose Legislature have made them the custodians of a most important trust—they owe it to the public at large, who are interested in a through line east—they owe it to the people of southern Ohio, languishing for want of a railroad connection with their commercial emporium on the west, and the Atlantic seaboard on the east—and finally, they owe it to the cause of truth, sustained against their course by their own engineer department.

XV. CONCLUDING REMARKS.

In the surveys now reported upon, the writer and his party have traced 157 miles of compass and level line—about four times the distance from Hillsborough to Chillicothe, all which has been accomplished within three months, and is mentioned here to show that very little of the ground could have remained unexplored within the narrow limits in which these routes were traced.

In fact no routes for a railway within the scope taken by the surveys of the writer, are practicable across this country, except those noticed in this report.

In conclusion I must state, (and I do so with much pleasure,) that in the execution of these surveys I have been ably and faithfully assisted in the field by Messrs. N. F. Jones, Peter Brady, and James J. Seibeneck, and in the office by Mr. Charles Cramer—all these gentlemen having manifested a degree of capacity, industry and fidelity most highly creditable to them.

All which is respectfully submitted.

ELLWOOD MORRIS,
Engineer in charge of Survey.

Cincinnati, May 16, 1851.

APPENDIX

[A.]

OF THE VALUE OF CURVATURE IN TERMS OF GRADE.

The value of curvature in terms of Grade, a matter of great consequence to Engineers, has never been fixed by any exact experiments.

The work of Gillespie, (on Road Making,) valuable as it really is, and extensively circulated as it has been in the West, has in a tabular statement, *over-valued exceedingly* the effect of curvature, in adding resistance upon Railways.

The Baltimore and Ohio Railroad Engineer Department, many years ago, by some imperfect experiments, fixed the curve of double resistance, at 200 feet radius, or say a 29° curve.

Since then, the eminent Engineer now at the head of that Department, has in the Wheeling controversy, intimated his opinion that the curve of double resistance, has a much longer radius, say 400 feet, or a 14½° curve.

Taking the grade of double resistance compared with a level, at 19 feet per mile, the rule intimated by Mr. Latrobe, *is nearly* 15 *inches of grade per mile to each degree of the quality of the curve*—the same as that used for flattening grade, upon the curves of the Ohio and Pennsylvania Railroad.

From some experiments that have come to the knowledge of the writer, he is inclined to think, that when the track is in good order, this rule of 15 inches to the degree, values the resistance of curvature too high, and until the matter is more definitely settled, he is inclined to take *one foot of grade per mile, for every degree of the quality of the curve,* as approximating sufficiently near the truth, for flattening grade upon curves.

This is a subject on which it is very desirable that further experiments should be made, and he hopes that some of his professional brethren, who have the means, will undertake a series of the proper kind.

APPENDIX

[B.]

ROCKY FORK AND PAINT VALLEY LINE.

TABLE OF HIGH AND LOW WATER.

LEVELS.

The total Levels referring to the Datum, of the Hillsborough and Cincinnati Railroad, taking the Red Oak Bench Mark, at the Depot, (shown by their Engineer,) at $567^{\underline{09}}$ or $618^{\underline{09}}$ feet above Low Water at Cincinnati.

Near Number.	Low Water about	Highest Water Level known.	Level of the top of the Iron Rail.	Top of the Rail above the highest known water.	Freshet Raise above low Water.	ALONG ROCKY FORK.	
	Feet.	Feet.	Feet.	Feet.	Feet.	Place.	Shown by
256	394.98	406.48	409.37	2.89	11.5	Hogshead's Farm.	Mr. Hogshead.
323	384.4	395.4	403.82	8.42	11	Mouth of C. Creek.	Natural Marks.
383	371.78	382.78	386.95	4.17	11	Scott's Bottoms.	Mr. Scott.
455	365.11	376.61	381.91	5.3	11.5	Tomlinson's do.	Mr. Tomlinson.
						ALONG MAIN PAINT CREEK.	
895	259.64	275.76	307.35	31.59	16.12	Indian Ford.	Mr. Mackerly.
1059	239.6	249.2	259.58	10.38	9.6	Big Falls.	Mr. Smith.
1186	216.1	231.1	235.28	4.18	15	Platter's Mill.	Mr. Platter.
1244	212.3	229.2	238.3	9.1	16.9	Seymour's Bridge.	1 foot ab'e. T. P
1319	200	215.13	224.84	9.71	14.7	Dill's Land.	Dills Hand's.
1366	193.19	208.19	214.4	6.21	15	Ward's Garden.	Mr. Ward.
1457	183.42	198.42	201.07	2.65	15	Cochran's Land.	Mr. Cochran.
1489	183.08	198.19	201.07	2.88	15.11	In Bourneville.	Dr. Littler.
1513	183	198.1	201.07	3	15.1	Levee.	Mr. Prather's.
1558	176.17	191.17	196.74	5.57	15	Scott's Bottoms.	Nancy Roston.
1595	174	188.15	192.21	4.06	14.15	Scott's Bottoms.	Wm. Ward.
1601	172.8	186.5	191.61	5.11	13.7	Narrows.	Mr. Coover.
1638	170.2	184.2	187.98	3.78	14	Platter's Land.	Mr. Cheyney.
1667		183.98	187.02	3.04		Op. Mrs. Platter's.	Mr. Platter.
1679		183.3	186.66	3.36		Daly's Land.	Mr. Daly.
						ALONG NORTH FORK.	
1866	168.7	179.6	188.54	8.94	10.9	Slate Mill.	Mr. Robinson.
1937	153.74	163.74	172.28	8.54	10	McDill's Land.	Mr. McDill.

APPENDIX
[C.]

COPY OF LETTER FROM

WILLIAM. H. CLEMENT, ESQ.,

ENGINEER AND SUPERINTENDENT OF THE LITTLE MIAMI RAILROAD COMPANY.

To Ellwood Morris, C. E.

Office of the Little Miami Railroad Company,
Cincinnati, April 11, 1851.

Sir:—Your favor of the 6th inst. is at hand. After the improvements in the Line are completed, which will be within the next year—the distance from Loveland to Cincinnati, will be 22¼ miles, and from Loveland to the Public Landing at foot of Broadway, 22¾ miles.

The distance from Loveland to the Ohio River at Columbia, (a good landing, and where freight can be delivered in quantities by Road, as cheaply as at Cincinnati,) 18½ miles.

The maximum grade descending, will be 26 feet to the mile for a distance of two miles.

The maximum grade ascending, will be 35 feet, for 1¼ miles.

There will be no grade exceedihg 15 feet per mile upon any curve with a radius of less than 2,500 feet.

On the sharpest curves, the grades range from 5 to 10 feet per mile.

We may be compelled to adopt 40 feet for the short distance, we intend to occupy the street in this City, but it is my impression, that we shall be able to make 35 feet the maximum for the whole line.

The least radius of curvature *is* 900 feet—the least radius *will be* 1,100 feet, as I intend as soon as we can find time to employ the Ballast trains in substituting gravel-banks for the clay, at points where the sharper curves have been temporarily adopted to avoid slips.

(*Signed*) W. H. CLEMENT.

APPENDIX

[D.]

Copy of a letter from C. D. Jaques, Esq., Chief Engineer of the Hillsborough and Cincinnati Railroad, relative to Air Lines between Hillsborough and Chillicothe.

To Ellwood Morris, Esq.,
Civil Engineer:

Sir,—In answer to your interrogatories, allow me to state briefly:

1st. The distance from Kennedy's starting point near the town of Hillsborough, by an Air Line, to the North Boundary Line of Chillicothe. Distance is.................................35.08

2d. From the same point as first in Hillsborough to Greenfield, Miles.
by an Air Line. Distance is............................16.29
Greenfield to Frankfort, Air Line. Distance is............11.46
Frankfort to North Line, Chillicothe. do 10.79

Total distance from Hillsborough to Chillicothe....... 38.54

3d. From the same point as first in Hillsborough to Bainbridge, Miles.
By Air Line. Distance is..............................18.82
Bainbridge to North Boundary, Chillicothe, by an Air Line.
Distance is...17.24

36.06

Miles.
4th. Air Line, Greenfield to Chillicothe.....................21.10
" " Hillsborough to Greenfield..................16.29

37.39

The above distances are taken from the original Plat of the Lines run under my directions—in the autumn of 1849 and the winter and spring of 1850—in each and every case the starting points near Hillsborough and Chillicothe are the same.

The stopping points of all these Lines in Chillicothe is the intersection of the North line of the corporation with High street, opposite to a bridge over canal. If the west center of the corporation were taken, it would add about ½ mile to the Greenfield Air Lines, and affect those from Paint Valley very little.

I have no doubt of the correctness of the Plat. It was made in the office of A. Latham, Esq. of Chillicothe, who will, I think, vouch for its correctness.

(Signed) C. D. JAQUES.

REVIEW

OF THE

PAINT VALLEY ROUTE,

AND THE

PRECEDING REPORT THEREON,

BY BENJ. H. LATROBE,

CIVIL ENGINEER.

BURNET HOUSE, CINCINNATI. OHIO,
MAY 17th, 1851.

GEN. W. H. BALDWIN,
President of the Hillsborough and Cincinnati Railroad Company.

SIR,—I transmit to you the accompanying report addressed to me by Ellwood Morris, Esq., Civil Engineer, and detailing the results of his surveys upon the Paint Valley route between Hillsborough and Chillicothe. In explanation of the circumstances under which this report comes to pass through my hands, I will say that, as already known to you, I was requested, some months since, by parties interested in that route, to recommend an Engineer to make a survey of it, which should be subject to my review as consulting Engineer. I accordingly recommended Mr. Morris, a gentleman long known to me and to the public as an Engineer of talent and matured experience. My present visit to Ohio has afforded me the opportunity of examining his work, and enables me, in presenting to you his report, to accompany it with the following remarks, which the shortness of my stay here, and the necessity that you should have the report at your disposal without delay, must make very brief.

Upon a careful perusal of Mr. Morris's report, after a satisfactory examination of the country between Chillicothe and Hillsborough, upon the leading line of his survey, I find indeed that he has left me little to say, his investigation of the whole subject having been thorough, and his treatment of it in his report able and conclusive upon all of the several points of inquiry.

It will be understood that my concern in the subject of the report, is with the professional question alone, and that I am acting there-upon altogether in my individual character as a civil Engineer, and not in that of an officer of the company with which I am connected, and from which no official interposition in this matter could with propriety proceed.

The questions which present themselves in this report for my decision as your consulting Engineer, are indicated by the several headings under which he has divided the topics of discussion; but there is occasion for my specially noticing a few of them only, which I go on to do.

Of the first four items embracing accounts of the Geology and Topography of the country between Chillicothe and Hillsborough, and the local question of the several possible lines for the railway about the latter place, it is unnecessary for me to say more than that I concur in the statement of facts, my observation having enabled me to satisfy myself of their accuracy.

Of the fifth head under which the "general principles governing the surveys" are set forth, I have to say, that I approve them. In the application of those principles which relate to the grades and curves, to the final location of the road upon the lines which may be ultimately preferred, there will be room and time for such considerations respecting the effect of the grades in relation to the direction of trade and cost of transportation, as it will be proper to attend to. The assumed breadth and slopes of road will give full average, quantities of excavation and embankment, although it will be better in making the road, to widen the cuts, and narrow the embankments, reducing at the same time the slopes of cutting, as suggested by Mr. Morris. The modes of construction for bridge superstructures are correct in principle, and if executed with proper skill and care in the details, will give substantial structures.

The remarks upon the subject of trestling meet my concurrence; at the same time, that manner of supporting a track for a time, and until material for embankment can be obtained, at a reasonable cost, may judiciously be resorted to as it has been on the Cincinnati and Hillsborough line, care being taken, in running trains over such work to reduce speed, especially upon curved lines.

As to the measure of value assumed by Mr. Morris, at $50,000 for every mile of length in the road gained; and used, as he remarks, by other engineers, I agree with its general correctness as an approximate rule. At the same time observing, what will be obvious to all, that the worth of distance saved depends upon a variety of elements, such as amount, description, direction of trade and travel, and the relative importance of the through and way business of a line; of the guage of 4 feet 10 inches width of track, it is only necessary to remark, that it is that prescribed by the Law of Ohio; and although the time will come when it will be expedient to make the guage of the whole line from Cincinnati to Parkersburg (by a slight alteration easily effected) *uniform* to that of the Baltimore and Ohio and the Ohio and Mississippi railroads—it is not now necessary to make any departure from the legal guage, especially as the line between Cincinnati and Chillicothe is likely to be worked, for a time at least, by the machinery of the Little Miami Railroad, the guage of which conforms thereto.

The 6th and seventh heads of the report present the particulars of the two leading lines traced, the one by the Rocky Fork and the other by the Fall Creek Ridge, to the Main Paint Creek, along the valley of which they both proceed by a common route to Chillicothe.

Of these lines the Rocky Fork was carefully located, and the Fall Creek Ridge was traced by an exploring line only, yet with sufficient accuracy to give a reliable estimate of distance, grade, curvature and cost.

Preference is expressed by Mr. Morris for the Fall Creek Ridge Line, for the reason that it is 1¼ miles shorter than the Rocky Fork line, and has a better system of curves. At the same time it is $8,113 more expensive, and has 51 feet more of rise and fall. Assuming with him, however, that in both these particulars, in which the Rocky Fork line appears to have the advantage, the Fall Creek Ridge Line can be made equal to it, I concur with him in recommending the latter as the best route between the present points of uniting and departure.

The 8th head of the report presents a view of the two alternative lines by which the city of Chillicothe may be entered from the west, and awards the preference to the "Turnpike line" in comparison with the Hydraulic line, as being $\frac{6}{10}$ of a mile the shortest, (for a through line eastward,) although $26,310, the most expensive to construct, and having 70 feet more rise and fall. The saving of $\frac{6}{10}$ of a mile to the through line, (continued east of Chillicothe) is of importance, and the interest of the city should be consulted in the determination of the route through her limits. At the same time the value of the two routes, (shown by the capital representing the making and working of them,) is so nearly alike that the decision between them may well be left, as suggested by Mr. Morris, to the direction of future circumstances, and I may express the opinion, (based upon the experience of cities elsewhere,) that the true interest of Chillicothe would be as well or better promoted by a line passing through its outskirts, with no disturbance of property lines, or Interference with street business, as by one obliquely intersecting so many streets and squares, with the consequent waste of ground and risk of accidents.

The 9th division of the Report treats of the estimates of cost. I have *critically examined* this important branch of the subject, and am gratified to be enabled to express my confidence in the sufficiency and fairness of the estimates, the prices of bridge superstructures appear low, but simple as they are intended to be in their plan—generally of short span, crossing the streams at low levels, and built with timber cheaply obtained from the immediate neighborhood, I think they will be found high enough. I am moreover informed that they are the same with those used in the estimates of the northern competing line via Greenfield, so that they are at least suitable for comparison with that line. The scale of prices used by Mr. Morris are it seems nearly 20 per cent. higher than those at which similar work on the Hillsborough and Cincinnati road has been executed, as I am assured with fair profits to the contractors. The cost of track is taken at the same with that of the Hillsborough road and the competing route just mentioned. The same remark applies to it as to the bridge superstructures so far as it is used as a standard of comparison. Should some of the items of the estimates prove too low, there is margin enough in other particulars to cover their possible deficiencies.

The 10th head of the Report contains the comparison between the Rocky Fork and Fall Creek Ridge lines, through from Hillsborough to Chillicothe, and assigns the preference to the *Fall Creek Ridge and Paint Valley line by the turnpike.* I have already expressed my general concurrence with this decision, with the qualifying suggestions expressed above. Either line would give a route seldom surpassed for directness, economy, and the other qualities of a good location. The final determination between them may be left until the business of actual construction is about to be entered upon.

Under the 11th head Mr. Morris describes in very full and interesting detail the location and construction of the Hillsborough and Cincinnati Railroad, and I am enabled to state, that from a careful inspection of the line of that work, both on paper and on the ground, the representations of Mr. Morris are sustained by the facts. The road on the whole is judiciously planned, and located on a line of remarkable adaptation to high speeds for passenger trains, and the structures promise to be as durable and substantial as are to be found upon most of the leading railway lines of the country. The work is in so forward a state as to make the opening of it at the time promised, (autumn, 1851,) easily practicable.

Mr. Morris under the 12th division of his subject speaks of examinations and surveys heretofore made between Hillsborough and Chillicothe, and shows them, when properly considered, to have been all confirmatory of the preference given to the Paint Valley line in its competition with the more northern route through Greenfield.

Under the 13th head he enters into a comparison of the relative lengths, cost, and other characteristics of the two routes, and as I think, succeeds in fully demonstrating the decided superiority, in all important particulars of the route by the Paint valley, his conclusion, in which I concur, being finally expressed by the position that the Greenfield line, if located so as to *cost the same* with the Paint Valley line, will be *four miles longer,* thus making the Paint Valley line the cheapest by $200,000 of *equivalent capital,* and if located so as to be as nearly as possible of the *same length* with the Paint Valley line, will cost the most by $200,000 of *actual* capital.

Before expressing an opinion upon this question of length and cost of the two lines, I should have been glad to have had the opportunity of examining the particulars of the location and estimates of the Greenfield line, to which I was unable to obtain access. The means of reaching the conclusion just expressed, were however furnished by published reports and other documents, and the evidence supplied by them I deem altogether sufficient to sustain it.

Of the remarks submitted by Mr. Morris under the 14th and 15th heads of his report, I have only to say that I consider them as indicating the true policy to be pursued by the Companies, jointly engaged in the great enterprise of connecting the Ohio at Belpre with Cincinnati. The Hillsborough and Cincinnati Company, undertaking to extend to Chillicothe, (*by a route shown, and indeed admitted to be the shortest and cheapest,*) their Line already near being completed to Hillsborough, the Cincinnati and Belpre Company, will be left with unimpaired means, to direct its undivided attention to the more difficult Section of the route from the Scioto, eastward to the Ohio. This would make the junction of the two works at the city of Chillicothe, standing midway upon the Line, and dividing it into two nearly equal stages, of about the length best suited for the daily run of Locomotive Engines.

It would be greatly to be deplored, if with the inducements to meet at that Central and important point, and there to unite, the interests of the two Works in a friendly co-operation; to effect the object of their incorporation, these two Companies should push past each other, the one to Cincinnati and the other to Belpre; thus if it were possible to succeed in such an undertaking, affording the singular spectacle of two parallel Roads, with the same Termini, simultaneously built for the same trade. The one Company pushing its Line eastward, might in seeking the shortest Line, cross the Scioto, at a more southern point than Chillicothe, and the other pressing westward, upon the Line of its present choice, would pass far north of Hillsborough, in the (however unsuccessful) effort to reach Cincinnati by a route avoiding that town. That a contest so unwise should be prosecuted much farther, is not to be seriously apprehended. The places aside of the proper route for the through Line may, (as shown by Mr. Morris,) be accomodated by branches better for their own interests, than by diversions of the main trunk—and at a less cost of capital; thus removing the only conceivable motive to such deflections from the direct course—and conciliating all the interests entitled to command attention.

Passing with Mr. Morris over the Line of his Survey, we took "*the Fall Creek Ridge Line*" and I availed myself of the vicinity of the Rattlesnake Crossing, upon the High Line of the Greenfield route to visit it; this, being the only point upon that Line, (excepting the two or three miles next to Chillicothe,) which the time at my disposal, permitted me to examine. In my passage over the Paint Valley Line, I discussed the subject of the grades &c, with Mr. Morris, and he concurred with me in the opinion, that in view of the heavy coal trade, probably to be carried at no distant day, over this Line from Jackson county to Cincinnati, and intermediate points, it would be highly important to reduce the planes ascending *westward*, to as low a limit as possible. In this view of the subject, the Paint Valley Line, assumes a still more important position, as by its adoption, those grades may either now or at a future time, be made as low as $26\frac{4}{100}$ feet per mile in that direction, with an increase of efficiency in the motive power, of nearly 50 per cent. when compared with grades of $39\frac{6}{10}$ feet per mile; the lowest limit to which it is believed the grades upon the Greenfield route could be brought down, even at heavy increase of expense in construction.

My attention being particularly called to the levels of the Line along the Paint Creek Bottoms, below the Big Falls, which levels, it had been asserted, were dangerously low; I became satisfied by the evidence to the contrary furnished me, that the grade of the Railroad had been placed everywhere by Mr. Morris, at a perfectly safe elevation, above the freshets of that stream.

Discussing also with him, the expediency of substituting a new channel for the Creek, across the Bends, between Black Run and Plug Run, (Scott's Bottoms,) instead of the two Bridges, projected at that point, we agreed in favoring this change of the stream, by which a considerable expense, now included in the estimates, would be saved, and with little damage to private property—some ascent and descent in the Line, being at the same time dispensed with.

In conclusion, I take occasion to acknowledge the receipt of your letter of the 17th inst., asking for the result of my observations upon the Hillsborough and Cincinnati Railroad. You will notice that I have fully replied to the enquiries of that letter, in one of the paragraphs of this Report, to which I beg leave to refer.

I am sir, with great respect,
your obedient servant.
BENJ. H. LATROBE,
Civil Engineer.

The Maps illustrating this Report, will be placed under a separate cover.

ILLUSTRATING THE REPORT

OF THE

PAINT VALLE

RAILROAD SURV

BETWEEN

HILLSBOROUGH AND CHILLICOTH

IN

STATE OF OHIO

BY ELLWOOD MORRIS, C. E.

NOTE.

MILES.

from Cincinnati to Parkersburg measured about 155

d line as proposed between the same points, will probably

ure 163

uncontrolled by local influences, might bring this distance

to about 175

ne from Cincinnati to Parkersburg (the terminus of the Baltimore ilroad) passes 3½ miles south of Hillsborough—10 miles south of —7 miles south of Athens.

y from Hillsborough to Parkersburg, leaves Chillicothe 7 miles to nd Athens 9 miles.

E. M.

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